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THE SURGICAL TREATMENT OF CHRONIC CONSTRICTIVE PERICARDITIS

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IN previous communications[1] the authors presented a study of the circulation in 9 patients with chronic constrictive pericarditis. At the time, 6 of the 9 patients had been subjected to the operation of decortication of the heart so that it was possible in two-thirds of the number to compare the measurements of the circulation before and after the heart had been partially freed of its constricting envelope. Briefly, it was found in this group of patients that the arteriovenous oxygen difference was increased, the venous pressure elevated, and the circulation time prolonged; while the cardiac output per minute, the stroke volume, and the cardiac index (cardiac output in liters per square meter of body surface per minute) were diminished. In the 6 patients subjected to subtotal pericardiectomy, these values tended to, or actually did, return to normal. The plan followed in making these observations and the methods employed are detailed in these communications. These observations have added to our knowledge of the pathological physiology of a disease which, in this country, has been studied particularly by White, White and Churchill, Beck and his associates, and Burwell and Blalock. The clinical manifestations of this syndrome have been well described by White, and it may be of interest again to bring together briefly the symptoms and physical signs which have contributed toward our recognition of this disease.

The diagnosis of chronic constrictive pericarditis should be considered in the presence of signs of congestive heart failure not associated with the common etiological causes. Organic valvular lesions have conspicuously been absent. Enlargement of the liver and ascites usually are present. Edema of the extremities and pleural effusions occur, but less frequently. Distention of the peripheral veins is a constant finding. The cardiac silhouette may be small, approximately normal, or moderately large. The paradoxical pulse has been present in every case in our experience. The pulse usually is small in volume, the blood pressure and pulse pressure low. The point of maximal impulse of the heart may not shift. Under the fluoroscope, decrease in or absence of motion of the several chambers of the heart may be observed, and absence of shifting of the heart may be confirmed. Calcification of the pericardium may

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The studies reported in this paper formed the basis of the 15th Arthur Dean Bevan Lecture in Surgery given by one of us (G.J.H.) in Chicago, Illinois, October 7, 1938.

[1]Stewart, H. J., Heuer, G. J., et al. J. Clin. Invest., 1938, 17: 581; Stewart, H. J., and Heuer, G. J. Arch. Int. Med. (in press).

be seen, or special x-ray studies, particularly lateral views, may be necessary to demonstrate it. The electrocardiograms are of low voltage of the *QRS* and *T* waves, and the latter may be "cove" in form in leads *I* and *II*. The electrical axis may not shift or may shift only slightly, but too much emphasis is not to be placed upon this finding. There may be slight left or slight right axis deviation. Normal sinus rhythm is usually present although auricular fibrillation may occur. Since 3 of our patients were observed during the stage of acute pericarditis with pericardial effusion and followed through the successive stages of absorption of fluid and constriction of the pericardium, this sequence of events probably is not uncommon. Patients with pericardial effusion in the absence of rheumatic heart disease should be kept under observation in order to detect the development of constrictive pericarditis. Tuberculosis as a cause of the disease was proved in only 1 of the 7 patients subjected to operation. We have already called attention to the pathological physiology of the circulation in this disease.

The surgical treatment of chronic constrictive pericarditis dates back to 1913 when Rehn and Sauerbruch both resected the pericardium for this disease. Schmieden followed their lead in 1918 and has not only maintained his interest in the surgical aspect of this condition, but has stimulated other surgeons abroad. In this country, Churchill in Boston was the first to perform the operation; and he, Beck in Cleveland, and Blalock in Nashville, have shown particular interest in the subject. While the results of surgical treatment undoubtedly are striking, a study of the cases of patients subjected to surgery as reported in the literature shows that the primary mortality following decortication of the heart is still high (33 per cent). Of the 143 cases we have assembled (exclusive of our own) 19 died upon the operating table and 28 died during the immediate postoperative period; in short one-third of the entire number subjected to operation. It becomes, then, of importance to discover, if possible, the factors concerned in the immediate mortality as well as those which influenced the late results. It is with the hope of adding to the general knowledge of the surgical treatment of chronic constrictive pericarditis that we report our own experiences and our study of the literature. We shall omit further reference to the historical aspects of the subject which have been covered so ably by White.

Of the 9 patients with chronic constrictive pericarditis whom we have studied, 7 have been subjected to the operation of pericardiectomy. All the patients have recovered from operation. Three patients are cured in the sense that their symptoms and signs have disappeared and they are able to lead normal active lives; 3 patients are markedly improved and 1 patient is improved although sufficient time has not elapsed accurately to evaluate the results of operation.

PRE-OPERATIVE TREATMENT

The pre-operative medical treatment we have used is similar to that in the treatment of heart failure due to other causes. The patients are kept in bed, given a low salt diet (2.0 grams daily) and a limited amount of fluids (1200 cubic centimeters). A high protein diet has been given because it was indicated in 2 patients due to the low value of their serum proteins and because, in the others, it seemed advisable to maintain the level of the serum proteins in order to hold fluids in the blood stream. Of the drugs used to mobilize fluids, mercupurin has been found to be the most satisfactory. It usually is given in 2.0 cubic centimeter doses intravenously at 3 day intervals. To some patients ammonium chloride, 3 grams per day, was given at the same time to enhance the diuretic effect. Theocalcin, 4.5 grams daily, urea, 30 cubic centimeters of a 50 per cent solution, twice daily and aminophyllin 0.1 gram three times per day were all tried but with less effect. From our observations the use of digitalis appears to be contraindicated in the medical treatment of these patients. Nevertheless, it seems necessary in those patients exhibiting auricular fibrillation to give this drug in adequate amounts to keep the ventricular rate slow. Abdominal and thoracic paracenteses were resorted to when fluid could not be removed by other measures. Patients were not subjected to operation until fluids accumulated in the

tissues and body cavities had been removed as much as possible.

ANESTHESIA

Of the 7 patients subjected to operation, 4 were anesthetized by the simple open drop ether method, 2 with drop ether administered through an intratracheal tube (Magill) and 1, with an ethylene-oxygen-ether mixture. All the anesthesias were smooth, satisfactory, and without cyanosis. In 3 of the 5 patients in whom the intratracheal method was not employed, the left pleura was slightly torn in exposing the pericardium. The small openings were immediately closed with fine silk and neither cardiac nor respiratory upsets occurred as a result of these misadventures. In the 2 cases in which the intratracheal method was used, the pleura was not torn. In all cases the pulse was rapid, ranging between 100 and 160, in the majority being 130 or over. It was usually not only rapid but in 2 cases irregular in rhythm. On the other hand, the respiration remained regular, adequate, and unaccompanied by cyanosis. While our experience is too limited to compare different methods of anesthesia in the operation of pericardiectomy, it can be said that ether has been highly satisfactory. In no case did we have the slightest anxiety regarding this part of the procedure. While we did not use intratracheal anesthesia in the majority of cases and our patients failed to suffer any ill effects from the slight opening of the pleura in 3 instances, we are inclined to think that intratracheal anesthesia is desirable. Our experience would indicate that in spite of the greatest care, the left pleura particularly is likely to be opened in exposing the pericardium for resection; and that the opening might be sufficiently large to cause respiratory embarrassment.

In reviewing the literature on this phase of the subject it appears that Schmieden, who has had the largest experience of any single individual abroad, favors local anesthesia. He is of the opinion that the difficulties of the operation are greatly diminished by its use and it is well tolerated by the patient since the pericardium and cardiac musculature are completely insensitive. Churchill favors intratracheal ether anesthesia, believing it desirable to employ general rather than local anesthesia because of the magnitude of the operative procedure and the possibilities of tearing the heart muscle and opening one or both pleural cavities. Beck raised the question whether the exposure of the heart and great vessels to atmospheric pressure was not harmful and concluded from his experimental work that this "pneumocardiac tamponade" caused a dangerous reduction in cardiac output. As a result he suggested a revival of the Sauerbruch negative pressure chamber in operations of this sort. Beck's view that failure of the peripheral circulation due to a reduced filling of the heart is a dangerous aspect of the operation is opposed by that of Churchill who finds that the real hazard of the operation lies in the possible overfilling of a weakened heart suddenly released from the support of its surrounding pericardium. Mindful of the two views we have, in our 7 cases, made particularly careful observations during the course of the operative procedure when the heart and great vessels were exposed to atmospheric pressure. We have been unable to determine that such exposure during the operation was harmful. On the other hand, the rapid enlargement of the heart after the removal of the pericardium, causing it to herniate through the pericardial defect, has been at times distinctly disquieting and has caused us to fear that the heart was being subjected to too great a strain. Churchill operates with patients in the semi-sitting position and keeps them semi-upright during their convalescence with the idea of reducing the venous return to the heart during and immediately after operation. In 7 patients we have seen no ill effects from a recumbent position during the operation and postoperative period. Nevertheless, we think that Churchill's point is well taken; and certainly conditions should be such as to permit changes in the position of the patient on the operating table and in the wards.

A study of the cases reported in the literature shows, as previously noted, that of the 143 patients subjected to operation, 19 died upon the operating table and 28 died during the immediate postoperative period. Of the former, some data regarding the cause of

death appear in 12; of the latter, in 23. It does not appear from these data that anesthesia was responsible for the deaths. These findings together with our own experience indicate that anesthesia, excepting by those in desperate condition, is well tolerated by patients with constrictive pericarditis.

APPROACH TO AND EXPOSURE OF HEART

A greater part of the ventral surface of the heart may be exposed by an approach upon the left side of the thorax; and at the primary operation a skin muscle flap is reflected upon this side. The position and extent of the flap may be determined by the position of the heart with reference to the overlying costal cartilages and ribs as shown in the x-ray film. We have found it desirable to expose the heart from its base to its apex; and to do so it may be necessary to resect inclusively the second to the fifth, the third to the sixth, or the second to the sixth costal cartilages and segments of the adjoining ribs. The skin muscle flap is formed by incisions which overlie respectively the uppermost and lowermost costal cartilages to be resected and which are connected by a vertical incision corresponding with the midsternal line (Fig. 1). The major pectoral muscle is freed from the sternum and ribs and reflected laterally with the skin flap. The costal cartilages and segments of the corresponding ribs are resected (Fig. 2). Thus far we have done a subperichondrial and subperiosteal resection and have preserved the intercostal muscles, which are divided at the left sternal border and together with the posterior perichondrium and periosteum are reflected laterally as an additional flap. The dissection is then carried down to the pericardium along the left sternal border, and the fat and connective tissue overlying it are carefully freed and stripped laterally carrying with them the reflection of the left pleura. It is during the course of this maneuver that the left pleura may be torn and, therefore, it should be carried out slowly and carefully. The pericardium is freed to the left lateral border of the heart from the apex to the base, in the course of which the left phrenic nerve may be brought into view. Having exposed the left pericardium, a similar procedure is carried out over the right heart and to its right border. In doing so the heart is depressed so as to create a space between it and the sternum, sufficient to allow the subsequent resection of the pericardium. In 6 of the 7 patients subjected to pericardiectomy, it was possible to resect the pericardium over the right heart without resecting any portion of the sternum; in 1 case (Case 7) the resection of the left half of the sternum seemed necessary to obtain sufficient exposure.

A review of the literature shows that surgeons interested in the treatment of this disease are in agreement that the primary approach to the heart should be upon the left side; and that a right-sided approach should be reserved for cases in which at the primary operation the pericardium over the right ventricle cannot satisfactorily be mobilized. Schmieden and Churchill favor the complete resection of the bony thoracic wall over the heart rather than a subperiosteal and subperichondrial resection, believing it desirable that a mobile thoracic wall over the heart should be maintained. In our own cases, the ribs and costal cartilages have reformed with the restoration of the normal thoracic wall; a condition which thus far in our experience has seemed consistent with satisfactory late results. Churchill and others proceed at once to the resection of the left half of the sternum finding that the additional trauma involved is compensated for by the greater ease in exposure of the right heart.

RESECTION OF THE PERICARDIUM

It has been our practice after fully exposing the pericardium, to incise it over the left ventricle and devote such time as may be necessary in establishing the most satisfactory cleavage plane between it and the heart muscle (Fig. 3). In some cases a satisfactory cleavage plane is at once evident and the mobilization of the pericardium may be proceeded with at once. Again, there may appear to be complete fusion between pericardium and myocardium making the dissection of the pericardium a time-consuming matter. In some cases the pericardium is thickened and fibrous but not calcified; in other cases almost a complete bony shell; in still others a fibrous

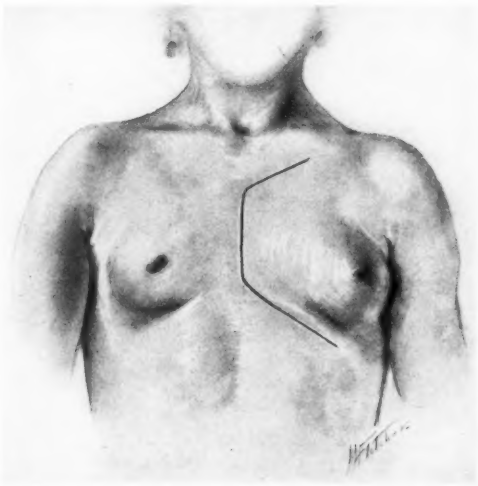


Fig. 1. The skin incision used in the approach to the pericardium. A flap of the major pectoral muscle of equal size is reflected laterally with the skin flap.

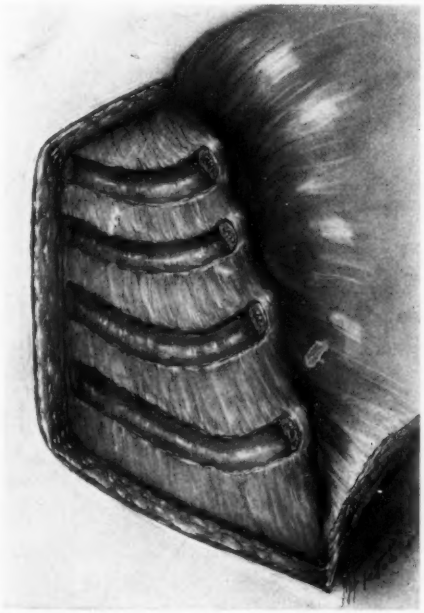
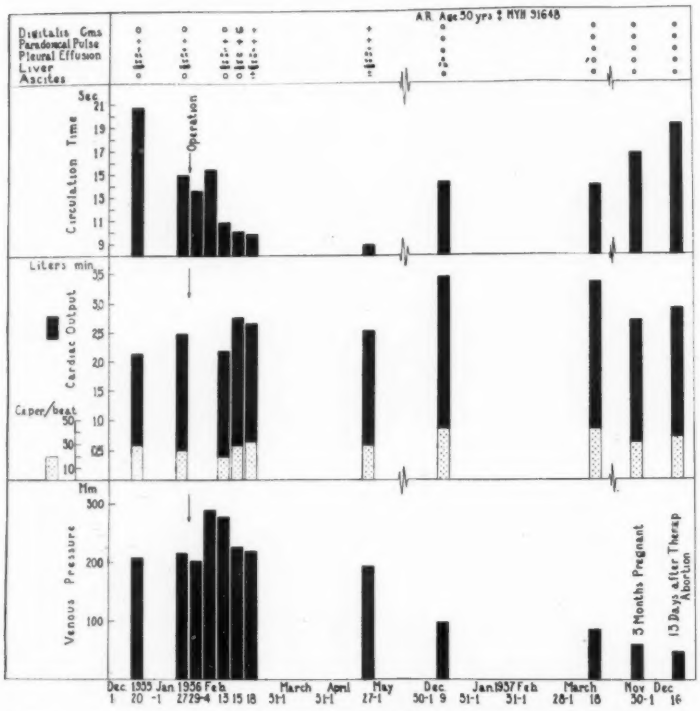


Fig. 2. Skin-muscle flap reflected laterally. The second to fifth costal cartilages, inclusive, with adjacent segment of rib are resected subperichondrially and subperiosteally. An incision is carried through intercostal muscles which are reflected laterally as an additional flap.

Fig. 3. Pericardium exposed. An incision is made through it over left ventricle; a cleavage plane between it and cardiac muscle is established. Mobilization of pericardium is carried out with knife, scissors, or blunt dissection.

Fig. 4. The resection of the pericardium completed.


A.R. Age 30 yrs ♀ MYH 31648
Digitalis Gms
Paradoxical Pulse
Pleural Effusion
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3 Months Pregnant
13 Days after Therap Abortion
Dec 1 1955 Jan 20 -1 1956 Feb 27 29-4 13 15 18 March 5-1 April 3-1 May 27-1 Dec 30-1 9 Jan 1957 Feb 5-1 5-1 March 28-1 18 Nov 30-1 Dec 16

Fig. 5. Case 1. Studies of the circulation before and after operation. These include observations on the circulation time, cardiac output, and venous pressure. Certain clinical observations before and after operation also are noted.

membrane containing areas or plaques of calcification of various size and distribution. Calcified areas may be present over the right ventricle but not over the left, may occur chiefly over the apex and diaphragmatic border of the heart or surround the great vessels at the base. They may be separated easily from the heart muscle or may extend into and involve the heart muscle. It is evident from these considerations that the resection of the pericardium may not be too difficult; or it may be extremely difficult and dangerous.

It has seemed best to us to dissect the pericardium off of the left ventricle first and for the reason that there is less likelihood of tearing into the left than the right ventricle in starting the mobilization of the pericardium. There is also less danger of overdilatation of the left than the right heart. The mobilization is carried lateralward so as to free the apex and left border of the heart, upward to the base of the heart, and downward to the diaphragm. A region where particular care is desirable is the interventricular groove containing the descending branch of the left coronary artery. It is here that adhesions between pericardium and myocardium may be particularly dense and it is possible, as in one case in our experience, that a part of the artery may be dissected out of its bed with the pericardium, the division of which might seriously interfere with the circulation of the heart. Having safely crossed the interventricular groove, the mobilization of the pericardium is carried out over the right heart; to the right, if possible, to the right auriculoventricular groove, upward to the base of the heart, and downward to the diaphragm. It has seemed easiest to resect the pericardium in fragments; but we have always carried the line of separa-

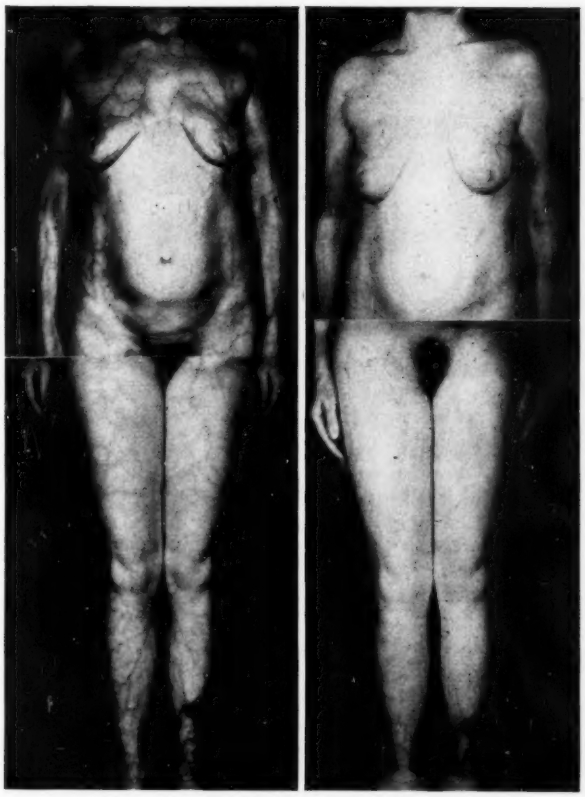


Fig. 6. Case 1. Infra-red photographs showing the gradual disappearance of the venous congestion. a, left, December 9, 1936, taken about 10 months after operation; b, November 30, 1937, taken about 22 months after operation. Improvement in this patient was slow but she is now "cured."

tion between pericardium and myocardium well ahead of the cut edge of the pericardium so as to maintain a flap of this structure which we could bring against, and suture to, the heart muscle if it was inadvertently torn. We have also at times abandoned the attempt to separate a plaque of calcification or a particularly adherent piece of pericardium from the heart, thinking it better to leave it as a patch on the muscle than to risk injury to the heart muscle in an attempt to remove it (Fig. 4).

How much of the pericardium it is necessary to remove in order to achieve satisfactory results is a difficult question. We have removed as completely as possible the pericardium over the left and right ventricles, but have not attempted to remove the adherent pericardium over the auricles. An effort has been made to free the apex, and if possible the dissection is carried well down on the diaphragmatic portion of the pericardium. No attempt has been made to go beyond the right auriculoventricular groove; nor have we attempted to free the great vessels at the base. Schmieden first removes the pericardium over the left ventricle and believes the primary removal of the pericardium over the right ventricle is dangerous; for the sudden release of the thin-

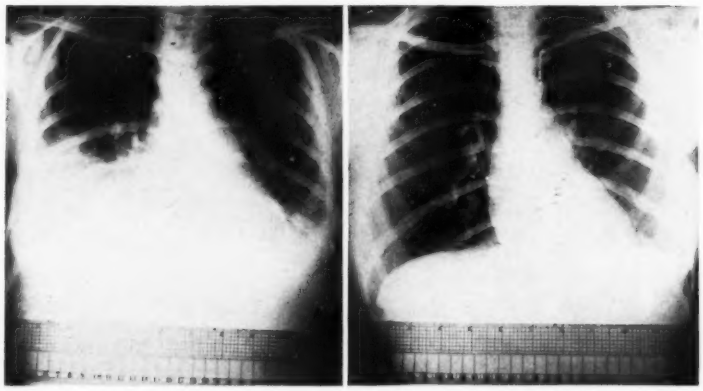


Fig. 7. Case 1. Roentgenograms of chest before and after operation. a, left, January 27, 1936, taken the day before operation showing the cardiac shadow and pleural effusion; b, December 16, 1937, taken 22 months after operation when designated as "cured." The earlier x-ray pictures taken before operation are not reproduced because the pleural effusion obscured the cardiac outline.

walled right ventricle at a time when the left ventricle is still supported, may lead to its sudden dilatation and even rupture. He attributes a death on the operating table to such an overdilatation. Churchill, Cutler, and Beck are in agreement with Schmieden. Burwell and Blalock, although admitting the theoretical possibilities, have failed to observe any harmful effects in cases in which the right ventricle was first subjected to decortication.

With regard to the extent of the decortication, Schmieden states that it is more important to consider what parts of the thickened pericardium should be allowed to remain to support the weakened heart than how much should be removed. Because of the danger of acute tricuspid insufficiency and to avoid a deficiency of the auriculoventricular valves leading to inflow venous congestion, Schmieden states that the decortication should not be carried beyond the coronary sulcus. He emphasizes also the liberation of the apex of the heart which may be firmly fixed to the diaphragm, a condition which prevents normal systolic contraction. If the apex cannot be liberated, he advocates a left phrenicectomy. Churchill points out that the sulcus formed by the descending branch of the left coronary artery is apt to be the site of unusually dense adhesions and that great care should be exercised in this region to prevent injury to this important artery. He is of the opinion that the mobilization of the right auricular groove is an important step in the operation; indeed, a "crucial" step in relieving obstruction to right ventricular filling. Several authors have referred to the importance of removing the scar about the vena cava, but Burwell and Blalock have made no attempt to remove it and have observed improvement in most of their cases.

Not only may the decortication of the heart be, of itself, a tedious and dangerous procedure, but it is made more so because of the necessity of operating upon an organ in constant motion and one very sensitive to external stimuli. In the 7 patients subjected to operation, the heart beat, as counted at the wrist, varied between 100 and 160 and in all cases was over 130 during the greater period of the operation. In 2 cases the heart action was fairly regular; in 5 markedly irregular. In some cases there were periods of paroxysmal tachycardia; in others transient ventricular fibrillation, in still others such complete loss of rhythm that the cardiac action could be described only as complete arrhythmia.[1] Periods of transient stoppage of

[1] In one case the application of 2 per cent novocain to the heart as suggested by Beck had no effect upon cardiac action.

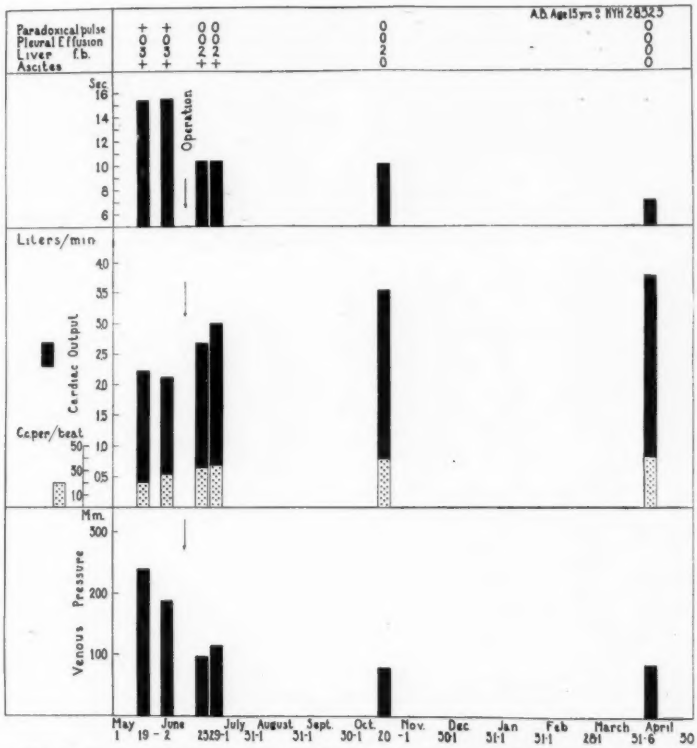
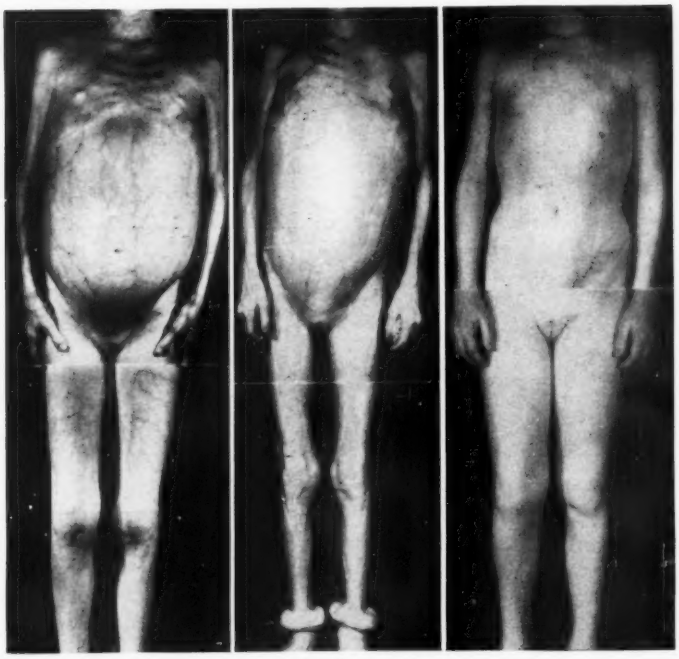


Fig. 8. Case 2. Studies of the circulation and notation of the prominent physical signs before and after operation.

the heart occurred not infrequently; and in the majority of cases the dilatation of the right ventricle and its herniation through the pericardial defect added to the difficulties of the procedure. The manipulations necessary in the mobilization and removal of the pericardium certainly play a rôle in the irregularity of cardiac action. All the circumstances tend to urge the operator to hurry and finish the operation—but it is a tendency to be resisted. It has seemed to us wise to pause periodically in the course of the operation in some cases, in order to allow the heart to regain a more normal rhythm.

That great care in the operative procedure is of importance in the success of the surgical treatment of chronic constrictive pericarditis is evident from a survey of the literature. A study of the records of 19 patients who died upon the operating table shows that in 7 no data referable to death are given while in 12 some data appear which might suggest the cause of death. Of these 12 deaths, 4 were the result of injury to the auricle (1) or ventricle (3); in 3 it was the result of, or at least associated with, the overdilatation of the right ventricle; in 2 it was ascribed to "cardiac failure" and "ventricular fibrillation" and 1 was the result of pressure pneumothorax. The 2 remaining patients are described as "extremely weak and cyanosed" and in "critical condition" when subjected to operation. Of the 28 patients who died after operation, data regarding the cause of death are lacking in 5. Of the 23 cases in which some data are available, death was due to injury to the ventricle during operation in 2; to wound complications (infection, empyema)



a b c

Fig. 9. Case 2. Infra-red photographs showing the striking change in the superficial venous bed following pericardiectomy. a, May 20, 1936, taken before operation; b, June 29, 1936, taken 3 weeks after operation; c, April 6, 1937, taken 10 months after operation. Note also the disappearance of the ascites and the remarkable growth of the girl which has taken place during this short period.

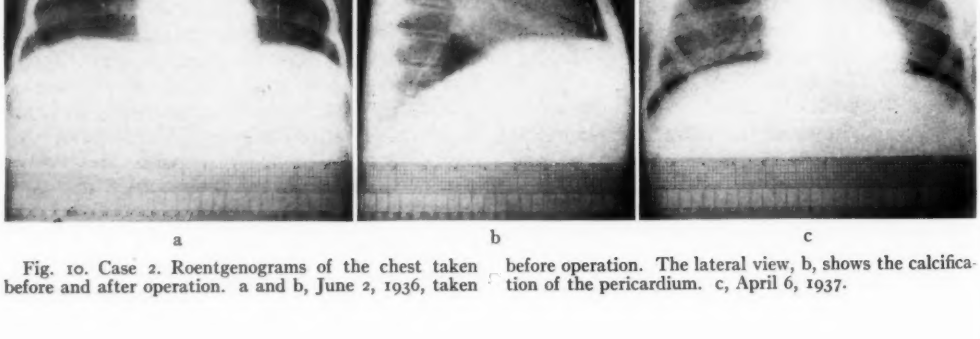


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Fig. 10. Case 2. Roentgenograms of the chest taken before and after operation. a and b, June 2, 1936, taken before operation. The lateral view, b, shows the calcification of the pericardium. c, April 6, 1937.

in 5; to acute cardiac failure (variously designated "acute failure"; "myocardial weakness"; "acute dilatation") within 48 hours of operation in 6; to late cardiac failure (18 days to 2 months) in 4; to tuberculosis in 2; and to a variety of causes ("angina," "cachexia," "exhaustion," "sudden no data") in 4. A summary of these findings shows that of 35 patients in whom data regarding death are available, 26 died upon the operating table or within 48 hours of operation; and of these 6 died as a result of injury to the heart during operation; 6 died of wound complications (infection, 5; pressure pneumothorax, 1), 11 died from acute cardiac failure; and 3 died without explanation other than that they were desperate surgical risks when subjected to operation. Almost one-half the deaths, then, were purely surgical and possibly avoidable; one-half were due to acute cardiac failure which immediately followed and well may have been the result of the surgical procedure. Whether some of these deaths might not have been averted by gentler manipulations at the time of operation is problematical.

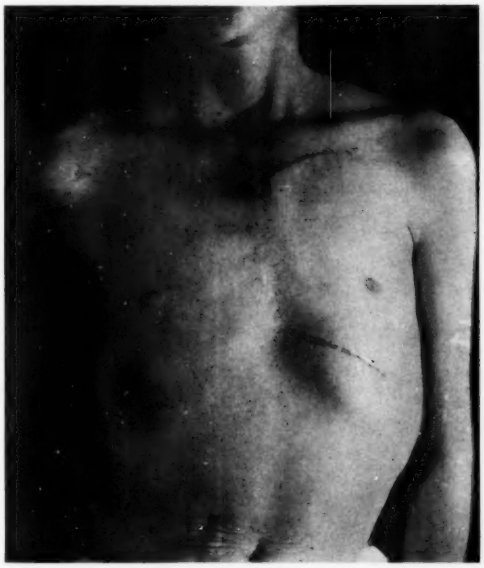


Fig. 11. Case 2. October 20, 1936. Photograph taken about 5 months after operation showing the scar of operation.

CLOSURE

In the 7 patients whom we have subjected to operation, bleeding has been controlled as perfectly as possible and closure of the large wound has been with silk and without drainage. In 6 cases, healing of the wound has been *per primam;* in 1 case a hematoma developed in the lower part of the wound followed by a localized, superficial infection which did not jeopardize the wound as a whole. In this case there also developed a moderate sized left hemothorax: complications the result of imperfect hemostasis. In the closure of the wound we have retained all the layers reflected, first resuturing the intercostal muscles and posterior perichondrium at the sternal border, then the major pectoral muscle, and finally the subcutaneous layer and skin. Schmieden not only resects completely the bony thoracic wall but excises the major pectoral muscle, using only the skin and subcutaneous tissue to cover the heart. Churchill resects the bony thoracic wall but retains the pectoral muscle. Both surgeons think a mobile thoracic wall over the decorticated heart is desirable. Our experience thus far in cases followed over 2 years indicates that the reformation of a rigid thoracic wall is not incompatible with satisfactory results.

POSTOPERATIVE TREATMENT

Five of our 7 cases had a surprisingly smooth postoperative convalescence and neither an oxygen tent nor any special form of postoperative therapy seemed indicated. Two patients were somewhat cyanotic soon after their return to the ward and were placed in an oxygen tent for a few hours. One patient, as previously noted, developed a hemothorax for which aspiration was performed. The same patient developed a local superficial wound infection which closed up under appropriate treatment. Subsequent to the immediate postoperative period the diet and salt and fluid intake prescribed before operation were continued for a time, as were diuretics when indicated. Three patients were found not to require them; 4 were given weekly injections of mercupurin, and 1, urea, after they had been ambulatory. Churchill

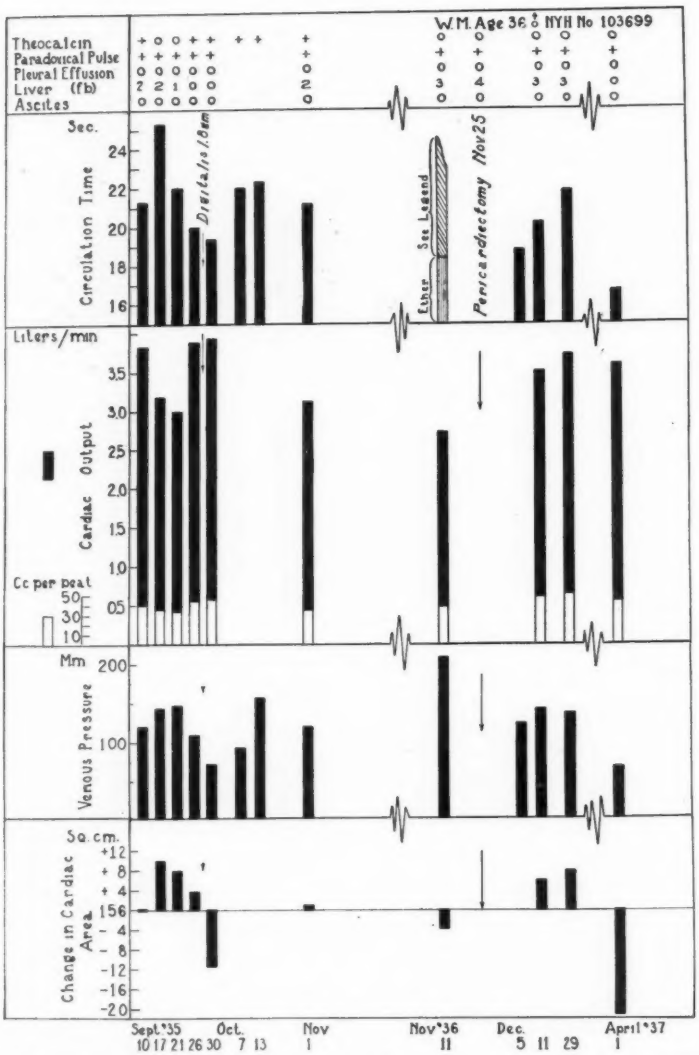


Fig. 12. Case 3. Studies of the circulation before and after operation. The circulation time was obtained with ether because the patient was sensitive to decholin. "Ether" time is shorter than "decholin" time since the former is "arm to lung" and the latter "arm to tongue."

routinely places his patients in an oxygen tent after operation but discontinues its use in a few days. He avoids transfusions and drugs as much as possible in the postoperative period.

CITATION OF CASES

CASE 1. A. R., History No. 91648, female aged 29 years, was first admitted to the New York Hospital, March 12, 1935. Four months before admission she began to suffer from nausea, vomiting, and weakness. Physical examination showed that she

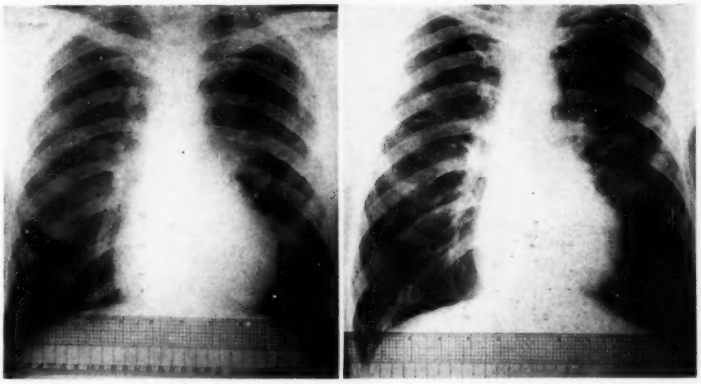


Fig. 13. Case 2. Roentgenograms of chest before and after operation. Comparison of b (September 22, 1938) taken 22 months after operation with a, left (November 11, 1936), taken before operation shows a decrease in the cardiac silhouette.

was 4 months' pregnant, had a marked pallor and enlargement of the spleen. The cardiac rate was rapid but there were no signs of heart failure. Blood cultures taken on March 21 and again a week later were positive for Streptococcus viridans in small numbers. A roentgenogram of the chest failed to show evidence of pulmonary tuberculosis; the cardiac shadow was not remarkable except for a prominence along the left ventricular border. The urine contained albumin, red blood cells and a moderate number of granular and cellular casts.

Within 6 weeks of her admission certain changes in her physical condition had become manifest. There was increasing distention of the veins of the neck, the appearance of râles at the bases of both lungs, progressive enlargement of the liver, and soft pitting edema of the legs. The radial pulse had become paradoxical in quality. On May 12, 1935, the patient left the hospital against advice but returned in 2 weeks with cyanosis, swelling of the ankles, and weakness. Examination at this time showed dyspnea, cyanosis, distention of the veins of the neck and right pleural effusion. The heart was not remarkable, the pulse paradoxical. The liver was enlarged, the uterus corresponded with that of a 7 months' pregnancy; there was no ascites. The legs were edematous. At rest in bed the pulse remained rapid, the dyspnea and cyanosis persisted. She was digitalized rapidly over a period of 24 hours after which a maintenance dose was continued for 2 weeks. The drug had no effect either on the pulse rate or daily output of urine. On June 17, 1935, the patient went into labor spontaneously and after 8 hours was delivered of a living premature infant. The puerperium was uneventful.

On July 12, 1935, she again insisted on leaving the hospital. She remained in bed at home for 2 months, then got up and was moderately active. Her symptoms of dyspnea and weakness increased and a progressive enlargement of the abdomen occurred. She, therefore, reentered the hospital on December 3, 1935. On admission dyspnea, cyanosis, and orthopnea were noted; marked distention of the veins of the neck; signs of a large amount of fluid in the chest; moist râles over the bases of both lungs; marked ascites, marked enlargement of the liver and edema of the legs. The heart sounds were faint, the rhythm rapid and regular, the pulse markedly paradoxical. Special studies showed an increase in venous pressure, a diminished cardiac output, and a delayed circulation time (Fig. 5).

The diagnosis of constrictive pericarditis in this case seemed positive, and operation was deemed advisable. The patient was given a diet containing 2 grams of salt, her fluid intake was restricted, ammonium chloride and mercupurin were administered. Abdominal paracentesis was performed on December 5, and 4000 cubic centimeters of fluid was withdrawn. Thoracentesis was performed on seven occasions and on each 1000 to 1300 cubic centimeters of fluid was withdrawn from the chest. The sediment from both abdominal and thoracic fluid was injected into guinea pigs with negative results for tuberculosis. As a result of all these measures the patient lost 14 kilograms in weight but later regained the weight.

Operation was performed on January 28, 1936, under ethylene anesthesia. A skin muscle flap was reflected upon the left side and the second, third, fourth, fifth, and sixth costal cartilages and the adjoining ribs were resected. The pericardium was exposed, was grayish white in color and appeared greatly thickened. When incised, the pericardium was found to be densely adherent to the heart but a line of cleavage was established. An area of pericardium 10 centimeters by 11.5 centimeters was removed. The excision extended to the left border of the left ventricle including the apex, to the right auriculoventricular sulcus, well up to the base of the

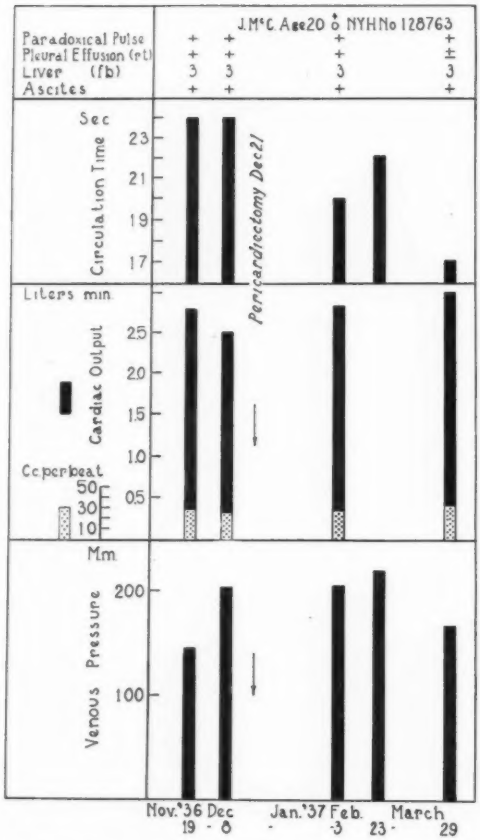


Fig. 14. Case 4. Studies of circulation before and after operation.

heart and down to the diaphragmatic pericardium. During the operation, the heart herniated through its pericardial covering in rather an alarming fashion but the cardiac rate and rhythm remained satisfactory. The wound was closed without drainage. The patient withstood the operation well. The postoperative course was uneventful. The study of the pericardium removed showed it to be a dense fibrous structure from 3 to 4 millimeters in thickness, microscopic sections of which revealed typical tubercles and giant cells indicative of a tuberculous infection.

The postoperative story of this patient is as follows: The physical signs of heart failure did not immediately change and during her postoperative period in the hospital she was treated with ammonium chloride, mercupurin, and theocalcin. She was discharged from the hospital a little over 2 months after operation with some, but not striking, evidence that the condition was greatly changed. But gradually her condition improved; 3 months after operation the signs of cardiac failure were greatly diminished and 5 months after operation had disappeared. Readmission to the hospital for re-examination approximately 1 year after operation, showed that all signs of her previous condition had disappeared. The paradoxical pulse was no longer present, venous pressure had returned to normal; venous engorgement had disappeared and circulation time was normal. She was leading her usual active life without symptoms. Fourteen months after operation the patient was discovered again to be pregnant and it was thought advisable to terminate the pregnancy. A therapeutic abortion under ether anesthesia was well tolerated. Eight months later the patient again was pregnant. She was readmitted, the uterus emptied and the fallopian tubes ligated to affect sterilization (Fig. 6 and 7).

At the present time, November 17, 1938, 2 years and 10 months after operation, she is in excellent health, does all her own work, and leads an active life, with no symptoms or signs of heart failure.

The case is an example of slow recovery after operation, and, as an apparent cure of tuberculous pericarditis, is unique.

CASE 2. A. B., History No. 20323, female aged 15 years, was admitted to the New York Hospital May 14, 1936, complaining of swelling of the abdomen for 5½ years. There was no history of exposure to tuberculosis. She had had a single attack of polyarthritis at 6 years of age but no other manifestations of rheumatic infection. There was no evidence of cardiac disease until at the age of 10 years her parents observed that she had become listless and her abdomen began to swell. The size of the abdomen increased and 4 months after the onset of symptoms she was taken to Bellevue Hospital where 3 abdominal taps were performed in 7 weeks, a large amount of fluid being obtained on each occasion. This treatment had no effect and some time later jaundice was present for a short period. About 6 months after the onset of symptoms, the abdomen still being greatly distended, she was taken to the Broad Street Hospital where an exploratory laparotomy was performed. The liver was found to be greatly enlarged and its surface studded with small excrescencies like tubercles. A diagnosis of tuberculosis was made. The swelling of the abdomen persisted but the child attended school regularly for about 4 years. At the end of this period the swelling of the abdomen increased still more and there appeared dyspnea on exertion, weakness, anorexia, and progressive emaciation.

On admission to the New York Hospital the girl appeared markedly emaciated and chronically ill. There was cyanosis of the lips, marked engorgement of the veins of the neck and increase in the size and number of the superficial veins over the entire body. The abdomen was greatly distended and full of fluid,

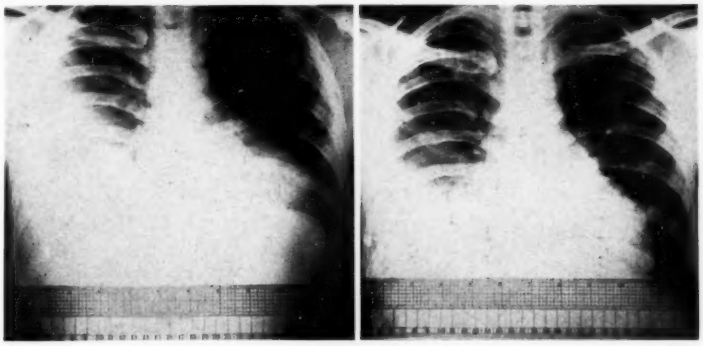


Fig. 15. Case 4. Roentgenograms of chest. Left, December 8, 1936, taken before operation. Right, January 29, 1938, taken 13 months after operation. The shadow due to pleural effusion persists.

the liver big and extending 8 centimeters below the right costal margin. There was no edema of the legs. The lungs appeared normal. The heart did not appear enlarged; the sounds were distant but otherwise normal. The rate was 126 per minute, the rhythm regular. The blood pressure was 88/52, the pulse definitely paradoxical. Fluoroscopy showed a small heart with marked diminution in the amplitude of cardiac contractions. X-ray films showed calcification of the pericardium over the right and the lower part of the left ventricle. Special studies of the circulation showed increased venous pressure, delayed circulation time, and diminished cardiac output. A positive diagnosis of chronic constrictive pericarditis was made and operation advised (Figs. 8, 9, and 10).

The pre-operative treatment consisted in complete rest in bed, a diet containing 2 grams of salt, restricted fluid intake, and the administration of mercupurin and aminophyllin. The drugs induced only slight diuresis and the result of pre-operative treatment was only slight decrease in the ascites. Operation was performed June 5, 1936, under ether anesthesia. A skin muscle flap was reflected over the left side and the second, third, fourth, and fifth costal cartilages and adjoining ribs were resected. The pericardium was exposed and appeared greyish white and on palpation greatly thickened. An incision was made through it and it was found that while the two layers of the pericardium were adherent, the adhesions were not particularly dense; a cleavage plane was therefore easily established and the mobilization and excision of the pericardium comparatively simple. Because of the extensive calcification of the pericardium, heavy instruments were occasionally necessary. The pericardium was removed over the left and right ventricles, an area 6 centimeters by 7 centimeters, as subsequently measured, being resected. The heart herniated markedly, but its rate and rhythm remained satisfactory. The wound was closed without drainage. Gross and microscopic examination of the excised pericardium showed a structure 3 millimeters in thickness with extensive calcification but no evidence of tuberculosis.

The postoperative course was remarkably smooth and uneventful. Within a month after operation the venous distention had decreased markedly, the pulse had ceased to be paradoxical, the liver had decreased in size, and the ascites had almost disappeared. The patient was discharged on the twenty-eighth postoperative day. She returned from time to time for re-examination. Her improvement continued, she developed physically in a remarkable way, and gained greatly in weight. At the present time (November 17, 1938) 2½ years after operation, she is a normal healthy girl leading an active life and able to engage in vigorous athletics. Careful examination reveals no symptoms or signs of heart failure (Fig. 11).

Case 3. W. M., History No. 103699, a male aged 36 years, was first admitted to the New York Hospital July 26, 1935, complaining of dyspnea on exertion and swelling of the ankles of 12 months' duration. With the exception of frequent colds and mild attacks of asthma his health had been good until 16 months before admission when he developed chills, fever and cough, productive of brown sputum. He entered the Morrisania Hospital where a diagnosis of bronchopneumonia was made. The report from this institution shows that he remained febrile for 2 months at the end of which time the temperature returned to normal. There developed, however, a bilateral pleural effusion, ascites, generalized dependent edema, enlargement of the liver, and distention of the veins of the neck. Except for a rapid rate the heart on examination was not remarkable. The patient was discharged from the Morrisania Hospital July 6, 1934. He remained short of breath on exertion, his ankles were swollen, he had a constant ache in the epigastrium, a cough with yellow expectoration and continuous mild wheezing. In the 12 months before admission to the New York Hospital, these symptoms increased and he developed orthopnea, precordial pain, and marked weakness.

a b c

Fig. 16. Case 5. Infra-red photographs taken before and after operation. a, May 26, 1937, taken after medical treatment but before operation. b, November 19, 1937, taken 4½ months after operation. c, January 28, 1938, taken 7 months after operation.

Physical examination on July 26, 1935, showed a man acutely ill with marked dyspnea, cyanosis, and orthopnea. The veins of the neck were markedly distended, the pulse was paradoxical in quality, the liver was enlarged, the abdomen contained fluid, and both legs were edematous. The heart was not remarkable, the lungs showed moist râles over both bases and many sibilant wheezing sounds. The blood pressure was 122/90. During the first 24 hours in the hospital, he was partly digitalized and perhaps, as a consequence, the distention of the veins of the neck increased. A phlebotomy was performed with the removal of 650 cubic centimeters of blood, a procedure which appeared to relieve his venous distention, dyspnea, and cyanosis. Both digitalis and phlebotomy were employed before the true nature of the condition was appreciated. Under rest in bed, a low salt diet, theocalcin, and a maintenance dose of digitalis, excellent diuresis was obtained. X-ray and fluoroscopy examinations of the heart, July 30, 1935, showed marked diminution in the amplitude of cardiac pulsations, no evidence of valvular heart dis-

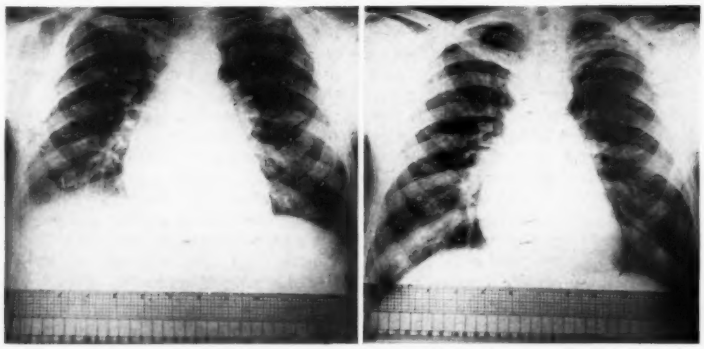


Fig. 17. Case 5. Roentgenograms of chest before and after operation. Left, June 15, 1937; right, November 19, 1937, taken 5 months after operation.

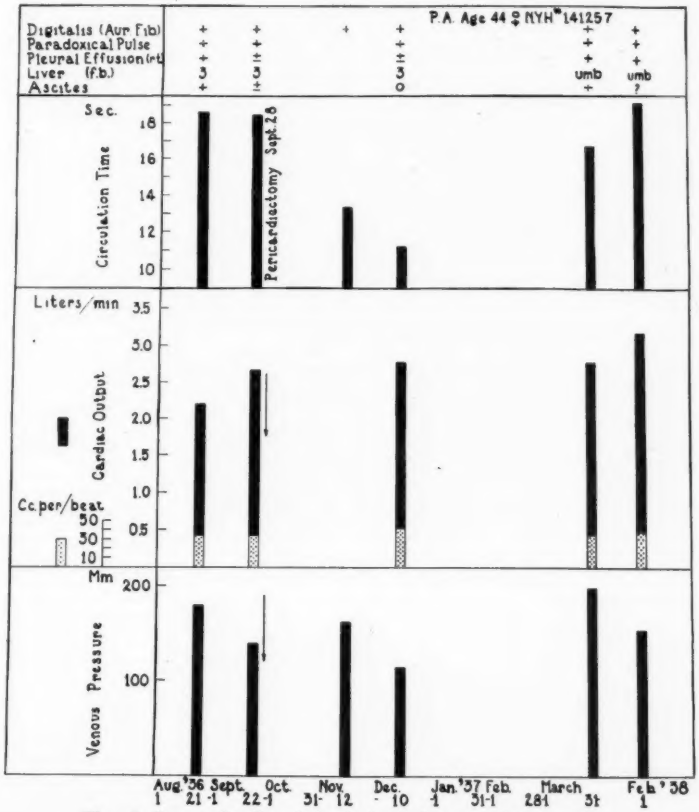
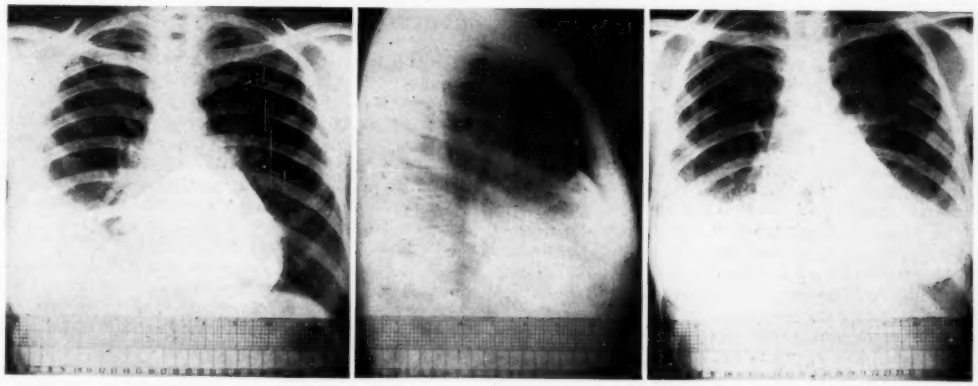


Fig. 18. Case 6. Studies of circulation before and after operation.



a b c

Fig. 19. Case 6. Roentgenograms of chest before and after operation. a and b, September 22, 1936, taken before operation show extensive calcification of the pericardium; c, December 10, 1936.

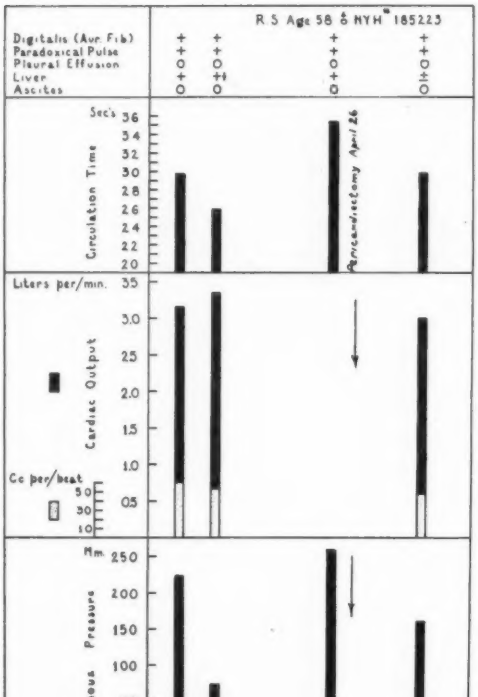


Fig. 20. Case 7. Studies of the circulation before and after operation.

ease and no pleural effusion. Under this medical treatment he improved and on October 10, was up and about ward. Discharged November 5, 1935, with the diagnosis of chronic constrictive pericarditis.

Following his discharge he returned to the cardiac clinic monthly for observation. He secured a position as night watchman and indulged in moderate exercise. Eleven months after discharge, he noted again increasing dyspnea, swelling of the ankles and a troublesome "fullness in the head" on exertion. He was readmitted to the hospital November 9, 1936, and on examination showed moderate dyspnea, cyanosis, and distention of the veins of the neck. The examination of the heart again failed to show anything remarkable. The pulse was paradoxical, the blood pressure 115/90. The liver was enlarged. There was no edema of the extremities. X-ray films and fluoroscopic examination showed slight enlargement of the heart, absence of motion of the right side of the heart but slight motion of the left ventricle. Operation again advised and he was put on our usual pre-operative treatment (Figs. 12 and 13).

Operation was performed November 25, 1936, under ether anesthesia. A skin muscle flap was reflected upon the left side and the second, third, fourth, and fifth costal cartilages and adjacent ribs were resected. The pericardium appeared thickened, and no cardiac pulsations were visible even with the pericardium exposed. An incision was made through the pericardium over the left ventricle, and a cleavage plane was established. Without untoward event an area of pericardium 8 by 10 centimeters was resected. The wound was closed without drainage. The pericardium resected was 2 to 3 millimeters in thickness and had the consistency of cartilage. Microscopic examination showed a fibrous tissue which in many areas had undergone calcification. No tubercles or other characteristic findings were present.

The postoperative course was uneventful. On the day after operation the veins of the neck were definitely less distended and within a week the venous engorgement had almost disappeared. Fluoroscopic examination of the heart 3 weeks after operation showed good pulsation where previously it had been absent. Improvement in his condition was progressive and on December 30, 1936, 5 weeks after operation, he was discharged. He was readmitted for examination March 31, 1937, and it was found that all symptoms previously noted practically had disappeared. Seen on January 21, 1938, he stated he felt as well as he ever had in his lifetime even though he was working hard every day and not restricting his activities. At present (November 17, 1938) 2 years after operation, he seems to be entirely well, is doing heavy physical labor daily and is without any symptoms or signs of cardiac failure.

CASE 4. J. McC., History No. 128763, a male aged 20 years, was admitted to the New York Hospital April 20, 1936, complaining of weakness of 1 week's duration. He had never had rheumatism or chorea. His health had been excellent until 7 months prior to admission when he had fever and pain in the chest and was told, after x-ray examination, that he had pericardial effusion. He was in bed 3 months, then went about and felt well until 7 weeks before admission when he began to suffer from dyspnea on exertion, orthopnea, and swelling of the ankles. These symptoms persisted, and 3 weeks before admission fever and pain in the lower posterior portion of his right chest recurred. He developed a nonproductive cough and pain in his left shoulder.

On admission the patient appeared acutely ill and feverish. There was slight dyspnea and cyanosis. Examination of the heart and lungs suggested a large pericardial effusion and right pleural effusion. The heart was regular and there were no thrills or murmurs. The blood pressure was 106/80. The radial pulse was paradoxical in quality. The liver was enlarged, the abdominal cavity contained fluid. There was no edema of the legs. The red cells numbered 6.7 million, the white cells 11,200. Fluoroscopy showed a large pericardial and right pleural effusion. The temperature rose daily to 39 or 40 degrees C. On the eighth day of admission the

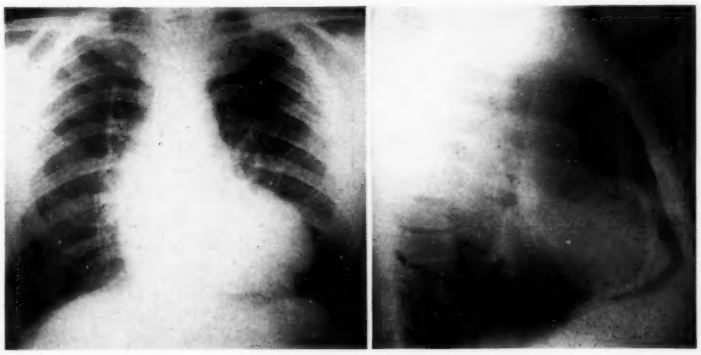


Fig. 21. Case 7. April 19, 1938. Roentgenograms of the chest before operation. The anteroposterior view shows the unusual extension of the left ventricle to the left. See operative note. The lateral view shows the heavy calcification of the pericardium.

patient was given acetyl salicylic acid and coincidentally the temperature fell 1 to 2 degrees. Mercupurin and ammonium chloride were given without inducing diuresis; nevertheless, repeated fluoroscopic examinations showed a steady decrease in the pericardial and pleural effusions. Two months after admission these could no longer be demonstrated although the other signs of heart failure remained unchanged. The patient was discharged June 28, 1936. The dyspnea, swelling of the abdomen and ankles continued, and he was readmitted November 18, 1936. The fluid in his chest had reaccumulated, there was distention of the veins of the neck, enlargement of the liver and ascites. Roentgenograms of the heart showed some enlargement to the left and less enlargement to the right. Fluoroscopy of the heart showed only very slight pulsation. He was again discharged but readmitted December 7, 1936, for resection of pericardium. The usual pre-operative preparation resulted in some improvement and a loss of 2.5 kilograms in weight (Figs. 14 and 15).

Operation was performed December 21, 1936. A skin muscle flap was reflected upon the left side and the third, fourth, fifth, and sixth costal cartilages and adjacent ribs were resected. The pericardium appeared opaque and thickened. It was incised over the left ventricle and found to be so densely fused with the heart that a cleavage plane was established and continued only with the greatest difficulty. The mobilization and resection of the pericardium was a difficult undertaking. An area 6.5 by 8.5 centimeters was resected. The heart bulged through the pericardial defect. Frequently during the dissection the heart became irregular, stopped beating temporarily, or exhibited periods of paroxysmal tachycardia. The wound was closed without drainage. The resected pericardium was 2 to 3 millimeters in thickness and on section showed a fibrous connective tissue, containing foci of polymorphonuclear leucocytes and lymphocytes suggesting an acute inflammatory process.

The patient withstood the operation well. A few hours after operation an increase in cyanosis was noted and he was placed in an oxygen tent. The morning after operation his condition was good and he was removed from the oxygen tent. Thereafter his convalescence was uneventful. His improvement was gradual but continuous. In his postoperative course ammonium chloride and mercupurin were given periodically. The signs of heart failure diminished but did not completely disappear. He was discharged from the hospital March 3, about 6 weeks after operation. Since then he has been re-examined from time to time. He has been up and about, has attended college regularly, is capable of moderate exercise, feels well, and is free from cardiac symptoms. Certain signs of his previous condition persist, as slight distention of his veins, engorgement of the liver, and a small amount of ascites. At the present (December 2, 1938) he is continuing his work at college. There are no symptoms of heart failure. There are signs of a small amount of fluid at the base of the right lung, enlargement of the liver to 2 fingers' breadth below right costal margin and minimal pitting edema of ankles. There is no longer distention of the cervical veins, nor signs of ascites. Mercupurin has not been required for 5 months.

Case 5. J. S., History No. 169168, a female aged 38 years, was admitted to the New York Hospital May 24, 1937, complaining of swelling of the legs of 6 years' duration. There was no history of tuberculosis or rheumatic fever. Her health had been good until 6 years before admission when she had a bout of fever, cough, and stabbing pain in the left scapular region. This illness confined her to bed for 3 months. She then resumed her usual activities but began to suffer from dyspnea on exertion, orthopnea and swelling of the abdomen and legs. She consulted a number of physicians who prescribed a variety of treatments including the administration of digitalis, injections of mercupurin, and the operation of thyroidectomy, which was performed 5½ years prior to

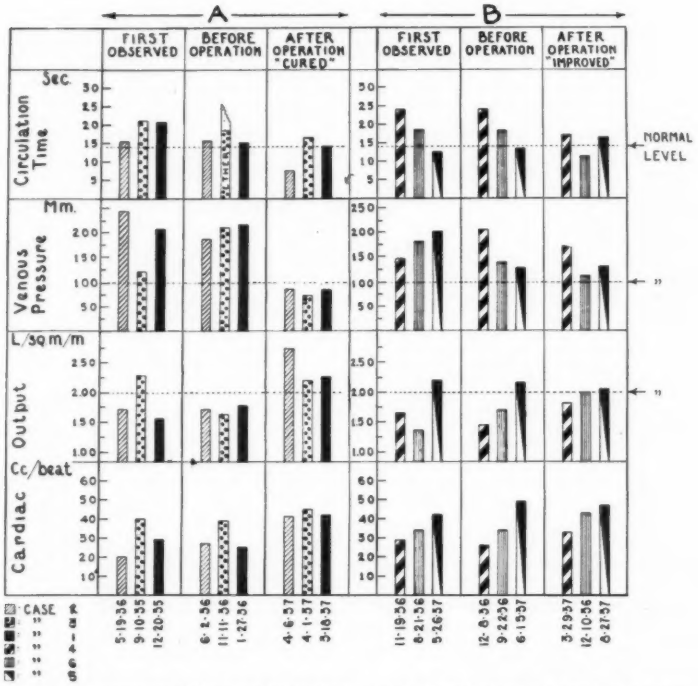


Fig. 22. Summary of the circulation studies in the first 6 cases subjected to pericardiectomy. Three cases in group A are "cured," 3 cases in group B are "improved."

admission. In spite of treatment her symptoms increased in severity and she entered the hospital.

Physical examination on admission showed a moderate dyspnea, orthopnea, and cyanosis. The veins of the neck were distended. The liver was enlarged, the abdomen contained a moderate amount of fluid, the legs exhibited a massive brawny edema extending well up on the thighs. The lungs showed moist râles at both bases. The heart sounds were fairly well heard, there were no murmurs and the rhythm was regular. The radial pulse was markedly paradoxical. The blood pressure was 130/78. Fluoroscopy of the heart showed only faint pulsation of the right ventricle and only slight pulsation of the left ventricle. The heart was slightly enlarged. Roentgenograms failed to show calcification of the pericardium. Under complete rest in bed, a diet containing 2 grams salt, restriction of fluid, ammonium chloride, and injections of mercupurin, there was some improvement. Theocalcin was then administered which increased the urinary output moderately. Three weeks after admission the dyspnea, cyanosis, and orthopnea were no longer evident. The liver decreased in size, the ascites had diminished and the edema of the legs was less evident. She had lost 13.4 kilograms in weight (Figs. 16 and 17).

Operation was performed June 27, 1937, under ether anesthesia. A skin muscle flap was reflected on the left side and the second, third, fourth, and fifth costal cartilages and adjacent rib ends were resected. The pericardium on exposure appeared opaque, hard, and thickened. It was incised over the left ventricle and found to be only loosely adherent to the heart. A cleavage plane was easily established and the mobilization and resection of the pericardium proceeded without difficulty. A large area of the pericardium was resected, the amount measuring 10.5 by 6 centimeters in diameter. The wound was closed without drainage. The pericardium removed was 3 millimeters in thickness, appeared fibrous and leathery, and on microscopic examination consisted of dense fibrous tissue with many foci of calcification. There were no tubercles or other significant findings.

The postoperative course was uneventful. At the end of 1 week the distention of the veins of the neck had diminished. Ammonium chloride and injections of mercupurin were used in the postoperative period and produced excellent diuresis which before operation they had failed to do. The patient was discharged 2 months after operation. Seen from time to time in the cardiac clinic, it became evident that under moderate activity there was a reappearance

of the previous signs and symptoms. She was admitted to the hospital October 8, 1937. Under appropriate treatment her signs again improved and she was discharged on December 5, 1937. Since then she has been followed in the cardiac clinic of the out patient department. At the present time (November 4, 1938), 1 year and 4 months after operation, she is quite able to do her own work. Her symptoms are slight dyspnea and moderate fatigability. Her signs of heart failure are very slight venous distention, enlargement of the liver to four fingers' breadth below the right costal margin, and moderate edema of the ankles. The radial pulse still is paradoxical.

CASE 6. P. A., History No. 141257, a female aged 44 years, was admitted to the New York Hospital on August 12, 1936, complaining of swelling of the ankles and abdomen. She had never to her knowledge had tuberculosis. At the age of 20 years she had fever and cough for a week, diagnosed as pneumonia by the family physician. At the age of 30 she suffered from acute polyarthritis but never had a recurrence of the condition. She was in bed for 2 months but it is not known whether there was any cardiac involvement at this time. At the age of 34 years, 10 years before admission, she first observed swelling of the ankles. There were no other cardiac signs until 10 years later when 2 months before admission she observed progressive swelling of the abdomen and slight dyspnea on exertion. About 2 months before admission she began taking digitalis each day and continued to do so to the day of admission.

Examination showed a well developed woman with dyspnea and cyanosis. The veins of the neck were engorged, the abdomen distended with fluid, the liver enlarged, the legs and ankles markedly edematous. There were signs of a moderate amount of fluid at the base of the right lung. The heart appeared moderately enlarged to the left, the cardiac sounds were distant and poor in quality but no murmurs were heard. The blood pressure was 110/70. The pulse was definitely paradoxical. The electrocardiogram showed auricular fibrillation, roentgenograms of the heart showed it to be globular in shape and slightly enlarged. There was extensive calcification of the pericardium. The fluoroscopy of the heart showed marked diminution in cardiac motion. X-ray films confirmed presence of fluid in right pleural cavity.

Treatment consisting of bed rest, a low salt free diet, restricted fluids, digitalis, ammonium chloride, mercupurin and theocalcin, led to excellent diuresis and general improvement. She lost 14.7 kilograms in weight (Figs. 18 and 19).

Operation was performed September 28, 1936, under ether anesthesia. A skin muscle flap was reflected on the left side and the second, third, fourth, and fifth costal cartilages and adjacent ribs were resected. The pericardium was opaque and showed extensive calcification. It was incised over the left ventricle and found to be adherent to the underlying myocardium. A cleavage plane, however, was established and the pericardium over the left and right ventricles mobilized and resected. The pericardium was especially adherent along the sulcus between the left and right ventricles but was finally freed without misfortune. The wound was closed without drainage. The pericardium, which was removed, measured from 5 to 8 millimeters in thickness. It consisted largely of a hard bone-like tissue. On microscopic section it was found to be dense cellular tissue with masses of calcification. There was a marked tendency to true bone formation with the development of bony trabeculæ.

The patient withstood the operation well and her condition continued excellent until the day after operation when she showed dyspnea, cyanosis, and on physical examination a moderate pneumothorax was found. She was placed in an oxygen tent; the treatment was effective and her temperature, pulse, dyspnea, and cyanosis were improved. Her further convalescence was uneventful. In her postoperative course, ammonium chloride and mercupurin were administered periodically. On discharge from the hospital December 19, 1936, the signs of heart failure were less evident but still present. Since discharge she has been followed in the cardiac clinic. Improvement has been slow but definite. At the present time (December 2, 1938), 2 1/6 years after operation, she does her own work. Her only complaint is occasional slight dyspnea. Her physical signs are a moderate amount of fluid at the base of the right lung, enlargement of the liver to 4 fingers' breadth below the right costal margin, questionable ascites, and moderate edema of ankles. Radial pulse still is paradoxical.

CASE 7. R. S., History No. 185223, a male aged 58 years, was admitted to the New York Hospital on January 17, 1938. He stated that his health had been good until 6 years before admission, and that he had passed an examination for life insurance 9 years before admission. Six years before admission he began to note dyspnea on exertion and swelling of the ankles. On examination in a cardiac clinic he was thought to be suffering from "hypertensive heart disease with heart failure." X-ray of the heart showed "marked dilatation of the left ventricle," and electrocardiogram revealed "low voltage of *QRS* in all leads, T_3 inverted, T_2 partly inverted." He was given digitalis but his symptoms did not improve. In the 6 years that ensued he visited a number of private physicians who treated him with digitalis and injections of mercurial diuretics but his symptoms persisted, and 3 years before admission to the New York Hospital dyspnea became so marked that he was forced to stop his work as a tinsmith. In the 2 month period immediately preceding admission he had been taking digitalis regularly and had been receiving an intravenous injection of mercupurin once a week in an attempt to control the swelling of the ankles. On admission to the New York Hospital January 17, 1938, there was slight cyanosis but no dyspnea or orthopnea. The veins of the neck were moderately distended when he sat erect. There were a few moist râles at the bases of both lungs, posteriorly. The heart showed enlargement to the left on percussion, and the rhythm appeared to be totally

irregular. There were no thrills or murmurs. The blood pressure measured 155/100. The radial pulse was paradoxical in quality. The edge of the liver was felt 5 fingers' breadth below the right costal margin in the midclavicular line. There were signs of a small amount of fluid in the peritoneal cavity. Both lower legs exhibited slight pitting edema. The hemoglobin amounted to 114 per cent. The count of the red blood cells was 5.4 million, and that of the white blood cells 10,000. The blood Wassermann was negative. The total serum protein was 7.1 milligrams per cent. An electrocardiogram confirmed the diagnosis of auricular fibrillation. Roentgenograms of the heart showed the pericardium to contain extensive deposits of calcium, more marked on the right side of the heart than on the left. Both the right and the left ventricles were observed to be enlarged. Fluoroscopy of the heart showed fairly good pulsations in the region of the left ventricle, and slight diminution of the pulsations on the right side of the heart. The patient was placed at bed rest. A diet low in salt was given, fluids were restricted to 1200 cubic centimeters daily and digitalis, mercupurin, and ammonium chloride were used. These drugs were only moderately effective in producing diuresis during the first 4 weeks in the hospital, but during the latter part of the patient's stay, marked diuresis was observed in response to mercupurin. On February 5, 1938, the weight had decreased from 80.0 to 74.6 kilograms. The only signs of heart failure on this date were slight cyanosis and enlargement of the liver to 2 fingers' breadth below the right costal margin. The radial pulse still was paradoxical in quality. The patient remained in the hospital for 3 weeks longer. There was no further change in the signs of the heart failure, and the weight did not change appreciably. He was discharged on February 27, 1938. Following discharge the patient indulged in only slight physical exertion. He returned to the cardiac clinic once each week and was given injections of mercupurin, 2.0 cubic centimeters intravenously. He restricted his intake of salt and fluid. In spite of these measures he again began to suffer from dyspnea on slight exertion and swelling of the lower legs. The patient was readmitted to the hospital on April 11, 1938, and operation was performed April 26, 1938 (Figs. 20 and 21).

Under intratracheal ether anesthesia a skin muscle flap was reflected laterally upon the left side so as to expose inclusively the second to sixth costal cartilages and ribs. The third, fourth, fifth, and sixth costal cartilages together with segments of the corresponding ribs were resected subperichondrially and a second flap of tissue consisting of the intercostal muscles was reflected laterally. The extrapericardial fat and connective tissue were stripped from the pericardium together with the reflection of the left pleura. It was found in this case that the right heart could not be satisfactorily exposed and, therefore, the left half of the sternum immediately was resected. It was found after the pericardium was exposed that a cuff or cone of dense calcified tissue surrounded the great vessels at the base of the heart, that this cuff or cone was continuous with an area of calcification which covered the right heart, but that the pericardium over the left ventricle was singularly free of calcification.

An incision was made through the thickened pericardium over the left ventricle and a cleavage plane between it and the heart muscle was established. Without great difficulty the left ventricle was uncovered well to the lateral border of the heart and the apex was completely freed. The separation of the pericardium from the right ventricle, however, was very difficult, for here it was not only calcified but densely adherent to the wall of the ventricle. Nevertheless, the right ventricle down to the diaphragmatic reflection of the pericardium was well exposed as it was as far to the right as the auriculoventricular groove. At the base of the heart, however, the calcified shell surrounding the heart and great vessels was so adherent that their exposure was not as satisfactory as in any of the 6 other cases. Throughout the operation, moreover, the heart was most sensitive to manipulations and was thrown into complete arrhythmia repeatedly. Application to the heart of novocain as suggested by Beck seemed to have no effect in improving the situation. Altogether, the operation was most trying and, from the viewpoint of freeing the base of the heart, the most unsatisfactory of the 7 cases we have subjected to operation. The operative wound was closed in layers without drainage. The patient left the operating table in good condition.

The portion of the pericardium removed consisted of 2 pieces, one 7 by 4 centimeters the other 4 by 3 centimeters in size. In places it was but 1 millimeter in thickness, in other places 4 millimeters in thickness. That over the right ventricle is largely calcified, the calcium deposit resembling thin bony plates as in an infant's skull. Microscopic sections failed to show any evidence of tuberculosis.

The postoperative course was entirely satisfactory for 3 days. Then he complained of some dyspnea at night. Eight days after operation the operative wound appeared puffy and there was dullness at the left base. A needle was inserted under the flap and 60 cubic centimeters of old blood withdrawn. The left chest was aspirated and 525 cubic centimeters of bloody fluid obtained. He was placed in an oxygen tent for short periods for the next 2 days. He continued to take daily doses of digitalis and to receive injections of mercupurin. He was discharged from the hospital July 9, 1938.

The patient was readmitted September 19, 1938, for a revision of his wound which still continued to drain. The sinus tracts were excised. The upper sinus extended from the midline rather deeply to the left and contained a quantity of granulation tissue, which was removed. Under the Carrel-Dakin treatment the wounds rapidly granulated and at the time of discharge October 16, 1938, were quite small. He continues to return to the clinic. On the last visit November 17, 1938, 7 months

after the primary operation, he stated that he felt better than at any time since coming under our observation. His symptoms are minimal and consist of slight dyspnea. His physical signs are slight cyanosis, increased venous pressure, enlargement of the liver to 4 fingers' breadth below right costal margin, questionable signs of a small amount of ascites and moderate edema of the extremities. An evaluation of the results of operation is not yet possible.

SURVEY OF THE LITERATURE

We have found in the literature reports of 143 patients in whom the pericardium has been resected for chronic constrictive pericarditis. Of the 143 patients, 50, or 36.6 per cent, are reported as cured and 25, or 17.4 per cent as improved. Forty-seven, or 32.8 per cent of the patients died either upon the operating table (19) or in the immediate postoperative period (28). In addition to the 47 patients who died as a direct result of the operation, 13 are listed as having died at variable times after discharge from the hospital. An analysis of this group shows that 6 of the 13 patients lived more than 1 year; Schmieden's 2 cases lived 3 to 6 years, respectively; Beck's patient lived 6 years; L. Rehn's patient lived 1 year; and Lilienthal's patient lived "several" years. It is probable that these patients were improved, and they are so listed in our summary. Seven of the 13 patients died from 2 to 8 months after operation and presumably as a result of the continuation of the disease. Data regarding the results of surgical treatment are lacking in the reports of 8 patients. The final analysis, then, shows that of 135 patients in the reports of whom data are available, 50, or 37 per cent, are cured; 31, or 23 per cent, improved; and 54, or 40 per cent, died, either during or soon after operation.

The permanency of the cures reported in the literature has been questioned particularly by Paessler. The immediate effects of operation may be striking and dramatic; in a few months a water-logged, bedridden patient may be transformed into an individual capable of engaging in vigorous athletics. In other cases this return to normal is more gradual and may occupy a year. The information in the literature regarding the permanency of these favorable results often is lacking but certain data suggest that the results may continue over a period of years. Of Schmieden's 6 reported cures, 4 are well after 10, 12, 17, and 18 years; and of Churchill's reported cures 6 are well after 2 to 9 years, of which 5 are well more than 3 years. Five additional authors report patients well after from 5 to 11 years; 6 report cures of more than 2 years.

Paessler, however, after an investigation of 71 cases, is of the opinion that the late results have not been as favorable as the immediate results seemed to promise. He states that his studies have shown that the improvement after pericardiectomy has, in an appreciable number of cases, been followed after years by ill health with new and different manifestations which, however, cannot be interpreted as a recurrence of the constrictive pericarditis. He suggests that the chronic constrictive pericarditis is but one manifestation of a general disease process, the relief of which by decortication of the heart may not be sufficient to cure the patient; that it is necessary in addition to search for every possible focus of infection which, if found, is to be eradicated as a part of the treatment.

At first glance this record of surgical results may not appear to be impressive. But in judging the results it should be appreciated that the disease is incapacitating and invariably fatal, and to have improved or cured 60 per cent of the cases subjected to surgery is, after all, a real achievement. It should be realized also that the 150 cases represent the sum of the experience of 49 observers, 27 of whom have operated upon only a single case, 7 of whom have operated upon 2 cases, and 6 upon 3 cases. Only 8 surgeons, so far as can be determined from the literature, have operated upon 5 or more cases. It would appear certain that with more accurate diagnosis, a better selection of cases, more attention to pre-operative and postoperative management and greater perfection and experience in the operative technique, the results of this surgical treatment of chronic constrictive pericarditis will improve.

SQUAMOUS CELL CARCINOMA OF THE EXTREMITIES

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THE occurrence of squamous cell carcinoma of the extremities is comparatively rare. It comprises not more than 1 per cent of all the carcinoma in different parts of the body (4). Volkmann was the first to call attention to this subject in 1889 when he analyzed 239 cases of carcinoma of the extremities. Thirty-nine of these were from his own clinic during a period of 20 years. Heiman, in 1898, studied 20,544 cases of carcinoma and found only 207, or 1 per cent, that affected the extremities. Broders found 44 cases in 2,000 admissions of general epithelioma, or 2 per cent, at The Mayo Clinic during the period of 1904 to 1915. De Asis, in 1926, found 17 cases of epithelioma of the extremities among 6,766 patients with carcinoma, or .3 per cent, that were admitted to the Barnes Hospital and the Barnard Skin and Cancer Hospital of St. Louis. At St. Luke's Hospital in New York in 31 years only 9 cases were admitted to the wards and 6 to the dispensary, and at the New York Skin and Cancer Hospital only 26 cases were found among 35,000 admissions (12). From January, 1923 to January, 1934, at the Stuyvesant Square Hospital only 60 patients with squamous cell epithelioma of the extremities were admitted (5).

In the radiation therapy department of Bellevue Hospital, New York, only 2 cases of squamous cell carcinoma of the fingers were found among 11,400 admissions. One case was reported by Rubenfeld in 1932, and the other by Siegel in 1937. Siegel found only 22 cases reported in the literature up to that time. At the Brooklyn Cancer Institute from 1928 to 1938 only 32 cases of squamous cell carcinoma of the extremities were found among 10,000 cases of carcinoma, or .3 per cent.

Von Brunn as well as other writers, accepts Volkmann's classification of carcinoma of the extremities: (a) those that develop on chronic inflammatory tissue such as ulcers, scars, fistulas, etc.; (b) those that develop upon warts, moles, congenital or acquired; (c) those that develop on previously normal skin. In von Brunn's series of 320 cases, 227 occurred in the first group, 46 in the second, and 48 in the third. To bring Volkmann's classification up to date, trauma should be added as a fourth group. Johnson stated that, "Epithelioma of the skin is induced almost exclusively by the chronic injury of previously normal or abnormal tissue." He reported 4 cases of carcinoma that originated on scar tissue following burns. He quoted Durand who reported 90 cases of degenerated scars, 70 of which were caused by old burns. In our own series, 3 cases occurred on old burn scars and 5 followed direct trauma. Fox described a case of epithelioma of the hand following the bite of a horse. He quoted a similar case of von Winiwarter and another case of Wurz of carcinoma of the forearm following the bite of a pig. Volkmann quoted a case that developed on the scar of a dog bite.

The age incidence of carcinoma of the extremities is higher than in any other malignancy. Males predominate over females in a ratio of 4 to 1. In our series of 32 cases the average age was 63, the oldest 86, and the youngest 33. Twenty occurred in males and 12 in females. The distribution of the lesion in order of frequency was: dorsum of hand and wrist, leg, arm, forearm, foot, fingers, and thigh. The toes and the palmar surface of the hand are very rarely affected. The upper extremities are more often affected than the lower extremities. In our series 19, or 59 per cent, occurred in the upper extremities: arm, 5; forearm, 2; dorsum of hand, 9; finger, 3; and 13, or 41 per cent, occurred in the lower extremities: foot, 4; leg, 7; thigh, 2. Cases 5, 10, and 15 had multiple squamous cell carcinoma in other parts of the body. The average size of the lesion was 4½ centimeters. The largest involved two-thirds of the leg and the smallest was 2 centimeters. The duration of the disease before admission averaged 2½

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years. The longest duration was 15 years and the shortest 1 month. Four cases originated in warts, 3 on scars from previous burns which occurred 24 and 35 years before. Three gave a history of itching followed by ulceration and 5 a history of trauma. The others gave the origin from "sores," "pimples," or "growths." The treatment previous to admission varied from salves, repeated cutting with scissors, to "sprinklings of ground glass over the wound, and smoke of rooster's feathers." The blood Wassermann was negative in all cases. Eighty-five per cent of the patients were not engaged in any industry, being "too old to work." Thirty-one patients were white, 1 was a negress.

Volkmann's observation in 1889 that epithelioma of the extremities is invariably of the squamous cell type still holds true. Only 3 cases of the basal cell type were found at the Brooklyn Cancer Institute during the past 10 years. These have been excluded.

Clinically, squamous cell carcinoma of the extremities appears in two forms: the ulcerative type characterized by indurated, irregular, rolled edges and necrotic base; and the cauliflower or solid form characterized by a fungating granulomatous or papillary appearance. The ulcerative type, although the less malignant, has great destructive properties. The indurated rolled edges become necrotic and break down, while the adjacent skin becomes infiltrated and assumes the characteristics of the former edge, thus spreading along the surface of the extremity. The purulent secretion causes further destruction by undermining the edges of the ulcer and extending downward, penetrating the subjacent tissue. attacking the periosteum, and finally resulting in necrosis and destruction of the underlying bone (Cases 22 and 25). The tumor then grows downward between the spicules of bone, where it meets no resistance (Fig. 1), or finds its way between the fragments of a pathological fracture. Although we may find carcinoma in the partially destroyed bone underlying the tumor, the carcinoma is part of the primary tumor and not of the bone. Even histologically proved cancer cells in sections of destroyed bone do not alter these findings. A similar case is illustrated by Kaufman in a man of 86 with an extensive carcinoma of the leg and a pathological fracture of the tibia and fibula with carcinoma between fragments.

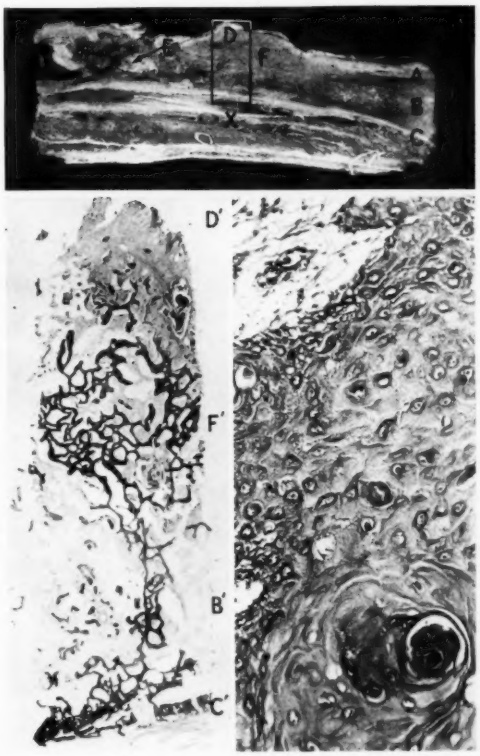

Fig. 1. Case 25. A above, Longitudinal section of amputated extremity showing *A*, anterior cortex; *B*, medullary cavity; *C*, posterior cortex; *D*, primary lesion of squamous cell carcinoma; *E* (arrow pointing), extension of carcinoma through the destroyed cortex into the medullary cavity; *F*, invasion of medullary cavity by bony trabeculæ and hyalinized fibrous tissue; *X*, cross section removed for histological examination. B, Photomicrograph of cross section *X'* showing *D'* primary malignancy. The anterior cortex is completely destroyed and replaced by hyalinized fibrous tissue; *F'*, considerable invasion of the marrow cavity by cellular fibrous tissue, with destruction and absorption of the bony trabeculæ; *B'*, some fatty marrow; *C'*, posterior cortex intact. C, Photomicrograph showing squamous cell carcinoma at *D* and *D'*. ×170.

The opinion that bone destruction is due largely to the admission of bacterial infection rather than to neoplastic invasion is shared by Willis. He states that in the majority of closed non-infected tumors which have enveloped and adhered to contiguous bones or car-

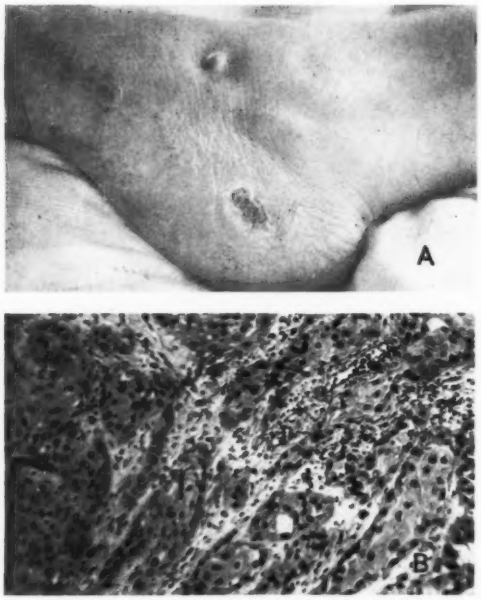

Fig. 2. Case 29. Healed squamous cell carcinoma of the foot with visceral metastases; A, primary lesion; B, photomicrograph showing squamous cell carcinoma of primary lesion.

tilages, the periosteum or perichondrium constitutes an effective barrier which excludes the growths from the bone or cartilage for long periods.

Roentgenologically, there is a variety of bone changes varying from periostitis (radiation and infectious), osteoporosis and osteomyelitis to areas of bone destruction and increased bone density. Eleven such cases, or 34 per cent, were found in our series: humerus, 3; metacarpal, 1; digit, 1; femur, 1; tibia, 3; and metatarsal, 2. In the presence of a carcinoma overlying the affected bone one does not wonder that some of these cases are interpreted as "bony metastasis" by the roentgenologist, the surgeon, or both, resulting in amputation which is not always indicated. This is well illustrated by our Case 26. Amputation was advised because of "bony metastasis." The patient refused operation and was not seen for 5 years. We considered her among the deceased. However, she was seen recently and proudly displayed her leg, stating: "I got cured without youse doctors. I still have my leg without doin' nothin'." Case 5 in our series had his arm amputated in 1929. The roentgenological report was "metastasis to the underlying bone." The treatment was undoubtedly indicated because of the extensive ulceration of the arm. The patient is still working, but one wonders how much the surgeon was influenced by the roentgenological report before he decided on amputation.

The cauliflower type is less destructive but has greater malignant tendencies, subject to recurrence and metastasis. However, metastasis in carcinoma of the extremities is extremely rare. If at all, it occurs late in the disease. De Asis explains this slow or late metastasis by the fact that the edges of the ulcer undergo thickening and induration, which are believed to squeeze the lumina of the lymphatic vessels, thus preventing the flow of the lymph which ordinarily carries the cancer cells. This explanation might be very consistent with the relatively benign course of the ulcerative type of carcinoma in which the edges of the ulcer are thickened and indurated. It also explains the relatively malignant course of the cauliflower type in which these factors are lacking in the majority of cases.

The regional lymph nodes are the first to be invaded, although the majority of the enlarged nodes are secondarily involved from the infection of the primary lesion and are not malignant. A great number of these enlarged nodes disappear when the primary lesion is removed. In our own series, 7 patients had palpable nodes, the smallest the size of a pea, and the largest the size of an orange. Internal and osseous metastases, although rare, have been reported in some instances. Mohr's case (quoted by Johnson) metastasized to the lungs, pleura, heart, and kidneys. He also quoted a case of Durand that metastasized to the iliac, pelvic, and lumbar lymph nodes, and produced a metastatic tumor in the liver as large as an orange. One of De Asis's cases of carcinoma of the leg metastasized to both inguinal regions and to the liver, as evidenced clinically by an enlarged liver with multiple nodules. One of the cases cited by Perez revealed general internal metastases which was proved by autopsy.

Among 334 cases of skeletal metastases from all types of malignancy reported by Geschickter 5 per cent metastasized from the skin. In Broders' series of 32 cases of metastatic squamous cell carcinoma, 1 metastasized to the upper and lower ends of the humerus, 1 to the rib, and 1 to the chest wall. In our series Case 1 had a tumor the size of an orange in the axilla with metastatic carcinoma in the corresponding lung. In our Case 29 autopsy revealed metastases to both lungs, heart, liver, spleen, kidneys, and pancreas (Fig. 2). On roentgenographic examination Case 23 in our series showed metastasis to the third lumbar vertebra. No other primary lesion except the leg could be found. Case 4 had roentgenographic evidence of metastases to the pelvis and upper third of both femurs, but the patient died at home. This patient had an enlarged prostate, which, however, was not proved malignant.

Treatment of squamous cell carcinoma of the extremities is mainly surgical. Of 256 cases of squamous cell carcinoma of the skin at The Mayo Clinic reported by Broders, 236 or 92 per cent were treated surgically. DeBell and Stevenson, at Stuyvesant Square Hospital, state that all squamous cell carcinoma of the skin are treated by surgery in that institution. They believe that this method of cancer therapy is particularly adaptable to lesions on extremities. Perez, of the New York Skin and Cancer Hospital, in reporting 26 cases of epithelioma of the extremities concludes that adequate surgical removal is the treatment of choice. He states that radiation, either by radium or roentgen therapy, is not satisfactory. Johnson, of the Radium Department of the Steiner Clinic, reports that the treatment with radium therapy of a tumor with a scar tissue foundation is unwarranted, and that curative treatment is strictly surgical. Adair, at Memorial Hospital, New York, states that amputation of the hand for epithelioma should not be a very common procedure. He believes that, "If the ulcerating epithelioma is still confined to the integument, the best treatment is the application of radium plaques, 1 or 2 applications of 1000 millicurie hours each." If the lesion has infiltrated the tissues deeper than the integument, irradiation of whatever type used is not effective. He concludes that if the lesion is large, deep, and painful, it often becomes necessary to amputate the hand.

In our own series of 32 cases, 16 received roentgen therapy alone; 7, x-ray therapy plus surgery; 6, surgery alone; 3, radium and surgery. Nine patients died, the youngest was 52 years, the oldest 82 years, the average age was 66 years. Four died from bronchopneumonia, 2 from cardiovalvular disease, 2 following amputation above the knee (24 hours and 1 week after operation), and 1 died from general metastases. Six patients could not be traced. When they were last seen they had no recurrence and were well for an average of 16.5 months following treatment. The average duration of cure in the 12 other patients was 2 years. The longest duration of cure was 8 years and 5 months. These patients are still being followed in our clinic.

One must agree with Adair that radiation has its use in the treatment of squamous cell carcinoma of the extremities; it also has its limitations. The ulcerative type, particularly, as pointed out by Adair, is too infected for conservative surgery; and one surely does not amputate for superficial ulcerated carcinoma. On the other hand, in the non-suppurative type there seems to be no logic in doing incomplete surgery for an adequate biopsy and not excising the whole lesion for curative purposes.

The deep-seated carcinoma and also the superficial ulcerating carcinoma that does not respond to radiation are exclusively surgical and amputation is the treatment of choice. We agree with Montgomery and Culver that these tumors are more resistant to radiation than those on the face, possibly because squamous cell carcinoma of the face is not associated with such predominant infection. A pre-radiation treatment consisting of thoroughly cleansing the ulcer several times a day for a number of days might stimulate better healing. We often find that following radiation therapy the healed ulcer will break down, not as a malignant recurrence, but because of the accumulation of purulent secretion beneath the healed layer. When this occurred in our Case 19 a number of biopsies were taken from the edge of the ulcer. They all

showed chronic inflammatory changes but no malignancy. Similar findings were present when the entire ulcer was excised and examined. No amount of cleansing will make an infected malignant ulcer suitable for conservative surgery, but it might improve the effect of radiation therapy.

If we find that an ulcerative carcinoma does not respond to radiation, it becomes a surgical problem. Further delay would only transform a superficial carcinoma to a deep-seated one, cause further destruction of the underlying tissue from the chronic infection, and increase the surgical risk.

Age and physical status of the patient are other factors that determine whether the patient should be treated by radiation or surgery, regardless of size or type of lesion. One, therefore, cannot make a hard and fast rule whether to treat squamous cell carcinoma of the extremities by surgery or radiation. Each patient must be treated individually.

The prognosis in squamous cell carcinoma of the extremities is very favorable. This disease runs a slow course and metastasizes late if at all. Though histologically malignant, clinically it is a relatively benign cancer. Recurrence is less common than squamous cell carcinoma of any other part of the body.

SUMMARY

1. Squamous cell carcinoma of the extremities is comparatively rare. It comprises not more than 1 per cent of all carcinoma in different parts of the body.

2. It is more common in males than in females, and the age incidence is higher than in any other malignancy.

3. Trauma is a contributing factor in a number of cases.

4. Metastasis is rare and late in the disease if it occurs at all.

5. The non-ulcerating type is comparatively more malignant.

6. The ulcerating type causes a great deal of destruction of the underlying tissues, resulting in various pathological changes in the bone which are often interpreted as "metastasis."

7. The treatment in the majority of cases is surgical. Radiation therapy is indicated in the superficial ulcerating types, not amenable to conservative surgery because of the infection and the poor surgical risk.

8. The prognosis is very favorable. Though histologically malignant, clinically it runs a relatively benign course.

9. Thirty-two cases of squamous cell carcinoma of the extremities have been studied and the findings summarized.

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THE PRESENT STATUS OF CHRONIC OSTEOMYELITIS

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BECAUSE it is relatively frequent and because it tends especially to affect the children of the poor who cannot pay for prolonged and often repeated hospitalization and the services of a private physician, chronic osteomyelitis is one of the most difficult problems encountered in the care of crippled children. Not only do these patients require prolonged hospitalization, but many of them need frequent dressings after they leave the hospital and, as will be shown, a considerable percentage of them are practically incurable.

We have reviewed 200 consecutive cases of chronic osteomyelitis which were admitted to the St. Louis unit of the Shriners' Hospital for Crippled Children, between the years 1924 and 1938 (6 per cent of 3,330 total admissions during this period). All of these patients gave histories of acute onset with fever and apparently their condition had resulted from an acute hematogenous osteomyelitis. No patients were admitted with chronic infection of the bone in whom the disease had resulted from a compound fracture or from the extension of an infection from neighboring soft tissues, except possibly extension into the bone from pyogenic joints. As we have not been able to separate these from the patients in whom the disease began in the bone, we have classed them all under the heading of chronic osteomyelitis. However, patients who had a primary pyogenic arthritis and who entered the hospital without chronic osteomyelitis were not included in this study. The series comprised 128 boys (64 per cent) and 72 girls (36 per cent). On admission their ages ranged from 10 months to 14 years and averaged 7.7 years. When admitted to the hospital the disease had been present from 12 days to 12 years and the average duration of the disease was 27 months.

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This hospital usually has a relatively large waiting list and patients are not admitted until they have been recommended by their physician and investigation has been completed to show that the parents of these children are not in a position to pay for private medical care. This precludes us from receiving patients with acute osteomyelitis.

In reviewing the histories of these patients we were interested in determining why they developed the disease. As to the cause of the acute osteomyelitis, nothing of importance was learned except that 25 per cent of the patients gave a history of a definite injury during the preceding week, and 40 per cent during the month preceding the development of the disease. With due allowance for the frequency of minor injuries in children, it seems probable that in a considerable percentage of the cases trauma plays a part in inaugurating the disease, or at least in determining the site of the primary focus. Preceding illness and foci of infection were not mentioned with sufficient frequency to be of etiological significance. It is our opinion that most of these patients were apparently normal, healthy children in whom the disease developed suddenly and for some unknown reason.

Fig. 1. A small localized osteomyelitis of the humerus, typical of a + lesion. There is no involvement of epiphyseal cartilage or neighboring joint. Acute onset with drainage of abscess 3 months later and sequestrectomy 5 months later. Small sinus still draining when last seen after 1 year.

Fig. 2. A more extensive process in the metaphyseal region of the femur demonstrating a ++ lesion. No involvement of epiphyseal cartilage or adjacent joint. There was an acute onset and treatment for inflammatory rheumatism was carried out for 4 months at which time the abscess was drained. Sequestrum extruded spontaneously after which the sinus healed and has remained healed for 18 months.

Fig. 3. An extensive involvement of the tibia demonstrating a +++ lesion. Most of the shaft has been destroyed but the process stops short of the upper and lower epiphyseal cartilages without any impairment in growth or adjacent joint function. Acute onset with drainage of abscess on fifth day. Sequestrectomy and saucerization 6 months later. Healed completely in 3 months and has remained healed for 3 years.

It was not possible in every case to determine how early the acute osteomyelitis was recognized but in 41 instances (20.5 per cent) it was stated that the patients were treated over periods of from 1 to 12 weeks for other conditions before a correct diagnosis was made. The false diagnoses and the number of times each was made are as follows: Rheumatism, 15; typhoid fever, 4; acute rheumatic fever, 3; phlebitis, 3; joint sprain, 3; malaria, 2; influenza, 2; pneumonia, 2; appendicitis (both operated), 2; fracture (without x-ray), 2; blood poisoning, 1; arthritis, 1; tuberculosis, 1.

In the majority of these, a correct diagnosis was not made until large subcutaneous abscesses had developed and in many instances not until these had ruptured and drained spontaneously. In others, osteomyelitis was ruled out because of an early negative x-ray and the erroneous diagnosis was adhered to until the x-ray picture showed changes in the bone. In the 2 instances with a diagnosis of fracture, x-ray pictures were not taken. The 2 patients who were diagnosed as appendicitis cases were subjected to emergency appendectomies and normal appendices were said to have been removed. Both of these patients had osteomyelitis of the shaft of the right femur and it is probable that inflammation of the retroperitoneal lymph nodes caused abdominal symptoms which led to the erroneous

Fig. 4. Massive destruction of the tibia demonstrating ++++ lesion. There is involvement of the entire shaft, the epiphyseal cartilage at the 2 ends, as well as involvement of the knee and ankle joint. Acute onset with drainage of abscess 6 days later. Additional surgery has not been performed because of poor general condition and multiple involvement. Drainage persists after 2 years.

Fig. 5. Extensive destruction in the femur demonstrating a ++++ lesion. There is involvement of the entire shaft, epiphyseal cartilage at the 2 ends, and involvement of the hip joint. Acute onset with drainage of abscess after 10 days. Admitted to this hospital 3 months later. Operation deferred because of poor general condition. Several sequestra extruded and after 15 months all sinuses closed and have now been healed for 1 year.

diagnosis. It is thus apparent that acute hematogenous osteomyelitis is frequently treated for some time as some other disease, especially rheumatism, and that the physicians in general practice who are the first to see these cases are not osteomyelitis conscious. This is true even today as 6 of these 41 cases have occurred during the past 2 years. It is also in order to reiterate that in the early stages of acute osteomyelitis, the affected bones cast normal shadows on the x-ray film and abnormalities of the bones are not disclosed by the roentgenogram until sufficient time has elapsed for the bone to be eroded or for new bone to be formed (from about 10 days to 2 weeks).

The site of the primary lesion is shown in Table I. It is to be noted that the large bones of the lower extremities (femora 95 and tibiæ 72) account for 83.5 per cent of the total and that there were no instances in which the primary focus was in the spine or cranium. From a study of the x-ray pictures on admission it was not always possible to determine whether the disease began in the diaphysis or in the metaphysis, but in the great majority of instances the disease appeared to have begun in the metaphysis near the epiphyseal line. In other words, the predominance of this disease is found in the large bones of the lower extremities which are most subjected to epiphyseal strains, and it suggests that this

Fig. 6. A, Broad adherent scar covering upper two-thirds of tibia resulting from healed osteomyelitis. B, Hair-line scar following excision of the original scar and shifting of pedicle flap to cover the defect. C, Double pedicle flap approximately 2 inches in width outlined with dye to show type of flap which is used. D, Split thickness graft on posteromedial aspect of leg, outlined with dye, which is used to fill the defect remaining after the flap is shifted.

may be an important factor in creating a point of lowered resistance where casual organisms in the blood stream may settle and find conditions favorable for growth.

However, 40 of 81 secondary foci developed in the metaphyseal regions of the femora and tibiæ and most of these occurred while the patients were ill in bed and trauma was not a factor. This inclines us to accept the theory of Hobo who demonstrated dilated capillary loops in the metaphysis adjacent to the epiphyseal cartilage plate. He found that bacteria and carbon particles injected into the blood of experimental animals tended to localize in these loops where the blood stream was slowed. Yet, the volume of the metaphyseal regions of these 4 bones is hardly sufficient to explain the marked predilection of the disease for these areas. Likewise, we recall the large sinusoids of the spleen and red bone marrow where the blood current practically ceases at times and wonder why these areas are not affected if the localization is due to a slowing of the blood stream. There were no patients with osteomyelitis of the vertebra in this series and only 7 in which the disease began in the pelvis. It is thus evident that we have no satisfactory explanation for the fact that in 83.5 per cent the disease began in the metaphyses of the femora and tibiæ.

We were interested in determining the type of treatment which these patients had received during the stage of their acute illness and, if possible, correlating this with the amount of bone involvement, with the number of instances in which joints were involved, and with those in which foci developed in other bones. It is to be noted from Table II, that in 50 per cent of the patients there was involvement of the joint adjacent to the focus in the bone, and in 25 per cent of the patients secondary foci developed in other bones. Many of the joints were destroyed and others showed a variable amount of limi-

TABLE I.—BONES INVOLVED PRIMARILY AND SECONDARILY AND LOCATION OF SECONDARY FOCI WITHIN THE BONE

Primary Foci			Secondary Foci			
Site	Number of cases	Cases with bone work during first week of illness	Metaphysis	Diaphysis	Differentiation not possible	Total
Humerus	11	2	6	5		11
Radius	2		1	0		1
Ulna	1		3	1		4
Femur	95	3	33	0		33
Tibia	72	3	7	0		7
Fibula	2		3	2		5
Foot	9	1			2	2
Phalanx					6	6
Mandible					4	4
Zygoma					2	2
Ilium	7				4	4
Rib	1				1	1
Scapula					1	1
Total	200	9	53	8	20	81

TABLE II.—CASES SHOWING SECONDARY FOCI AND JOINT INVOLVEMENT ACCORDING TO BONES

Site of primary lesion	Total cases	Secondary foci	Adjacent joint involvement
Tibia	72	23	27 (20 knees, 7 ankles)
Femur	95	17	55 (14 knees, 41 hips)
Humerus	11	4	3 (2 shoulders, 1 elbow)
Other bones	22	6	15 (9 in feet, 5 hips from ilium, 1 elbow from radius)
Total	200	50	100

TABLE III.—CASES OF SECONDARY FOCI AND JOINT INVOLVEMENT IN RELATION TO TYPE OF PRIMARY TREATMENT

Type of treatment	Total cases in entire series.		Secondary foci		Adjacent joint involvement	
	number	per cent	number	per cent	number	per cent
Bone work in 1 week	9	4.5	1	11	1	11
Soft tissue drainage in 1 week	42	21	9	21	17	40
Bone work later	22	11	4	18	10	45
Soft tissue drainage later	62	31	23	37	35	56
Spontaneous rupture of abscess	18	9	5	28	11	61
No drainage and no treatment	47	23.5	8	17	26	55
Total	200		50	25	100	50

tation of movement and loss of function. These complications were present on admission and practically all of them developed during, or shortly after, the acute stage of the disease. It is recognized that metastatic foci may develop late in chronic osteomyelitis, but these are relatively rare when compared with the number which develop early in the process.

We believe that in acute osteomyelitis the bone should be drained as soon as possible after the onset of the disease provided the patient is in condition to stand the operation, and we believe that early and adequate drainage of the bone tends to prevent or limit the extent of the chronic bone infection and to decrease the number of instances in which joints or other bones will be involved (4, 5). This study was undertaken with the hope of furnishing evidence for or against the above beliefs. We have arbitrarily fixed the first week of the disease as the period during which we consider operative intervention as being early, but we by no means consider operation at from 6 to 7 days as really early enough. Unfortunately for our study, the bone was opened during the first week of the disease in only 9 patients in the entire series (4.5 per cent, Table III). Among these 9 patients (femur 3, tibia 3, humerus 2, and foot 1), the adjacent joint was involved in only 1 instance and there was only 1 secondary focus in another bone (11.1 per cent as compared with 50 per cent and 25 per cent for the entire series). However, the number of patients so treated is too small to warrant definite conclusions as to the efficacy of this form of treatment.

It is further to be noted from Table III that soft tissue drainage, which was done in 42 patients during the first week, did not greatly decrease the number of complications, while drainage of the bone after the first week did not increase the number of complications. In the patients who had soft tissue drainage after the first week or in whom the abscesses

TABLE IV.—DEGREE OF PRIMARY DESTRUCTION AND END-RESULT IN RELATION TO TYPE OF PRIMARY TREATMENT

Type of treatment	Amount of primary destruction				Total cases entire series	End-result			No x-ray follow-up
	+	++	+++	++++		poor	fair	good	
Bone work in 1 week	0	3	4	2	9	1	3	4	1
Bone work later	3	5	9	5	22	8	5	4	5
Soft tissue drainage in 1 week	8	14	16	4	42	9	14	16	3
Soft tissue drainage later	6	16	18	22	62	28	18	13	3
Spontaneous rupture	4	4	7	3	18	6	5	2	5
No drainage and no treatment	3	21	18	5	47	19	11	12	5
Total	24	63	72	41	200	71	56	51	22

ruptured spontaneously the incidence of complications was relatively high.

In 47 patients no abscesses had been drained or had ruptured spontaneously before admission, and in these the number of secondary foci was relatively low (17 per cent), while the joint involvement was relatively high (55 per cent). It is believed that in many of this group the primary infection was one of rather low virulence.

In the 50 patients who developed secondary foci, there were 81 metastatic lesions (Table I), an average of 1.62 lesions per patient. Thus a patient who develops one secondary focus is liable to develop others. Thirty-eight of the 50 patients with secondary foci were among the 100 patients in whom the adjacent joint was involved. This may be interpreted as evidence that secondary foci are more frequent among patients in whom (1) the adjacent joint is involved, (2) in whom the infection has broken through the epiphyseal cartilage plate to involve the epiphysis, or (3) in whom the primary disease is relatively extensive.

We have also divided these patients into 4 groups, depending upon the extent of the pathology in the bone where the primary focus occurred as shown by the x-rays made on admission. These are classed as +, ++, +++, ++++ pathology in the bone and naturally the groups are not sharply demarcated. Figures 1, 2, 3, 4, and 5 illustrate lesions which we regard as being typical of each group. We have attempted to correlate the extent of the bone pathology present on admission with the type of treatment which these patients received during their acute illness (Table IV). A study of this table, however, does not permit the drawing of any definite conclusions and it appears that the degree of bone destruction was not definitely influenced by the early treatment which was given in this series. Apparently the disease tends to be self-limited, the bone is invaded very rapidly, and the amount of bone destroyed varies directly with the virulence of the invading organism and inversely with the resistance of the individual. If drainage is to be effective in limiting the spread of the primary focus, it must be done very early in the disease.

As most of these patients came from the country or small towns, cultures of the foci or of the blood were rarely made during the acute illness, and we have no data regarding the organisms responsible for the disease. Neither have we any information regarding the frequency of septicemia, except that 3 of the patients were said to have had positive blood cultures.

TREATMENT

The treatment which these patients have received has been fairly uniform throughout the 14 year period. Most of the patients have been operated upon and the operation which we perform consists of the removal of any sequestra encountered and a wide saucerization of the cavity. As much as possible of the chronically infected bone is removed without the amputation or resection of bone. Care is taken not to contaminate clean joints or to destroy epiphyseal cartilages, and we avoid the leaving of deep bone cavities with overhanging edges or tunnels through the bone. These can be filled with muscle flaps and may heal; but experience has shown that in the majority of these, in which healing occurs, the disease recurs and the operations fail to give satisfactory results.

The operations have been performed by or under the direct supervision of the various orthopedic surgeons on the staff of the Shriners' Hospital during this period and always, we believe, by men competent to do as adequate a saucerization as could reasonably be expected on the various patients assigned to them. Consequently we have no quarrel with the quality of the surgery which these patients have received. This is important because, as will be mentioned later, we have not cured all our patients. We believe that most of the failures have been due to incomplete removal of infected bone. This occurred because in some cases it is absolutely impossible to remove all of the infected bone without the grave danger of producing greater and permanent disability in the extremity.

At present the procedure at the Shriners' Hospital is as follows: The operation is performed under a tourniquet when one can be used. After the wide saucerization is completed, the wound is packed with dry, fine mesh gauze in order to control the bleeding, and a dry dressing is applied. A cast is not applied unless there is danger of a fracture of the residual shaft or involucrum from slight violence. On the third postoperative day, the gauze pack is removed under gas anesthesia and a vaseline gauze pack is inserted. This is changed at intervals of from 2 to 4 days. After the first 2 or 3 dressings the wounds are lined by granulation tissue and little pain is experienced by the patients. If at any time the granulations do not appear healthy, wet dressings are used and the wounds are irrigated with normal salt solution for a few days. Vaseline gauze then is again substituted. This method is continued until the wound is healed or the patient leaves the hospital. It seems to be just as efficient as the Orr method and eliminates the odor which is so objectionable when the latter method is used.

One of us (J. A. K.)—most of whose work is carried on in other hospitals where it is necessary that the hospital stay be as short as possible—routinely uses the vaseline pack and plaster cast immobilization as advocated by Winnett Orr. The procedure which has been described by him (6) has been followed with a reasonable degree of accuracy. Three slight modifications have been introduced and it is believed that they have been of some value: (1) The surrounding skin is covered with heavy zinc oxide ointment to protect it from the scalds and small furuncles which are so common when pus remains in contact with the skin under a cast. (2) In unusually foul and odoriferous infections, iodoform gauze is mixed with the vaseline gauze in an attempt at least to change the odor. (3) Where a reasonably satisfactory operation has been performed, large deep wounds are closed with a single layer of through-and-through sutures of silkworm gut, leaving wicks of vaseline gauze extending down to the bone and projecting at intervals between the sutures. The sutures and the vaseline gauze wicks are removed after the usual interval of 2 to 4 weeks and the small cavities remaining are repacked with vaseline gauze and a new cast is applied. By this method it is frequently possible to invaginate the soft tissues into deep cavities in the bone, and not only to shorten the time of healing and to limit the width of the scar but also to render healing more certain.

In addition to the above, we have used the Carrel-Dakin method and various types of wet dressings and other chlorine antiseptics. A few years ago when the newer mercurial antiseptics appeared we packed our wounds with gauze impregnated with merthiolate ointment, but we could not persuade ourselves that the wounds healed any more rapidly or more surely than did similar ones in which ordinary vaseline gauze had been used. We have even used gauze impregnated with ordinary hog lard and it seems to work just as well as any of the other preparations. We tried this in order to find some substance which would always be available to those patients who live in inaccessible places and who are required to do their own dressings. We have not used maggots because they are expensive, and we have not believed that they have any especial advantage unless the wound contains necrotic tissue. Our postoperative wounds contain no loose fragments of dead bone which the larvæ can bring up and deposit on the surface and relatively little necrotic soft tissue. The infected bone which

is left is beyond the reach of maggots or of any chemical or other agent which can be applied to the surface of the wound. Hence, we do not use bacteriophage. It has been amply demonstrated that this agent is inhibited by the body fluids and that bacteria in chronic infections quickly become immune to a bacteriophage.

Observations upon these and other patients with chronic osteomyelitis convince us that the permanent cure of chronic osteomyelitis in children over 3 years of age depends upon the thoroughness of the operation and not upon the after treatment. If all of the infected bone can be removed, the wound will heal and stay healed if it is kept open so that it heals from within out; and it matters little what type of dressing is used as long as it is not actually harmful. It should also be remembered that the smaller the opening, the more rapid the healing, as long as drainage is assured. Hence, our method of partial closure at the operation for saucerization.

If all of the infected bone is not removed, the wound may heal or may continue to drain indefinitely depending upon the activity of the infection and the geography of the wound; but even if it heals, the wound remains a potential source of trouble because the infection may become active again and cause a flare-up of the old disease. This is because human beings do not tend to develop an effective degree of immunity to the staphylococcus or to the streptococcus regardless of the period of contact with the organisms, nor has any means been found as yet which will confer such an immunity (2).

RESULTS OF TREATMENT

Of the 200 patients in this series it has been possible to follow 98 of them over a period of 3 years or longer. Of these, 60 were apparently cured and had shown no evidence of active disease during the 3 year or longer period, while 38 had evidence of active disease during that time. Of these 38 failures, 24 had been healed and apparently cured during part of the 3 year or longer period, but the disease had recurred and abscesses had formed. In the remaining 14 patients the disease had remained clinically active during the entire period of observation. In these 14 cases of persistent drainage, there was involvement of epiphyseal plates or of neighboring joints.

Of the remaining 102 patients it was possible to follow 38 of them over a period of from 2 to 3 years. Of these, 16 had remained clinically healed for at least 2 years, while the remaining 22 revealed evidence of some activity during this time.

Thirty-seven of the 64 remaining patients were followed for a period of from 1 to 2 years. Of these, 22 were clinically well and the 15 remaining still had evidence of active disease. There remain 27 patients who failed to return for additional observation or were followed for less than 1 year. There were 2 amputations and 1 death in the series of 200 patients. The death resulted from an attempt to do an adequate sequestrectomy on an involved hip joint. Only 1 resection was performed and this was for removal of a portion of 1 rib.

Our failure to cure 38.7 per cent of the 98 patients who were followed for 3 years or more is not entirely due to the extent of the bone pathology present on admission because they were graded as follows: 4, +; 18, ++; 9, +++; and 7, ++++; while the 3 year cures consisted of 7 +; 24, ++; 18, +++; and 11, ++++ involvement. In regard to the bones affected, the 3 year cures were: femur, 35; tibia, 14; humerus, 1; and other bones, 10. Our failures were due to our inability to arrest the activity of the disease. This is due to the fact that in a bone which is chronically infected, the infection is by no means limited to the abscess cavity or to the adjacent bone, but eburnation of bone extends for a considerable distance up the shaft and this contains minute, temporarily walled-off islets of infected granulation tissue which may give rise to an active infection in the future. Furthermore, it is the rule rather than the exception for a bone which is extensively involved to show pathology throughout the entire extent of the bone in the involved area. At the saucerization operation a part of this area is always left to preserve the integrity of the shaft, and this so called pencil of bone is always infected bone. It is thus evident that relatively few of our saucerization operations

accomplish the purpose for which they were devised, namely, removal of all of the infected bone and the creation of a wound which can heal from within outward without leaving a dead space which will harbor chronic infection. Fortunately, in 61.3 per cent of our patients followed for 3 years or longer, the wounds healed and remained healed for 3 years or more in spite of incomplete removal of infected bone. In 38.7 per cent of this same group it was not practicable to create sufficiently favorable conditions by operative procedures to arrest the disease over the 3 year period.

Our observations lead us to believe that in any extensive series of patients with chronic osteomyelitis there is a considerable number (probably one-third) in whom, because of the extent of the involvement, permanent cure is impossible without complete, or almost complete, removal of the entire bone which is involved. We look with grave suspicion upon the various series of such cases in the literature in which all, or nearly all, of a given series were cured by one means or another (1). We believe that it is time the medical profession admitted this and realized that in the treatment of acute osteomyelitis the prevention of widespread destruction of bone is almost as important as is the saving of the life of the patient.

In addition to checking our patients as to whether or not the disease appeared to have been arrested, we have also evaluated them on a functional basis (Table IV) and endeavored to correlate the result with the treatment which the patients received during the acute stage of the disease. Poor results are those with a marked deformity, complete loss of function in the adjacent joint, complete destruction of an epiphyseal line, or persistent drainage, and these comprised 35.5 per cent of the 200 patients. Fair results are patients showing a slight or moderate deformity, as some impairment of joint function, slight disturbance of growth, or a slight amount of drainage, and these comprised 28 per cent of the series. Good results represent those patients in whom the disease appeared to have been arrested without residual deformity or important disturbance in growth and without significant loss of function in the adjacent joints. This result was obtained by us in only 25.5 per cent of the 200 patients.

In some patients extensive scars cover the bone after healing is complete. These scars are attached to the bone, are poorly supplied with blood, and are covered by a thin layer of epithelium. They tend to break down with superficial ulcerations following relatively slight trauma. They heal very slowly and because of their persistent character, are often mistaken by the patient for a flare-up in the bone infection itself. Because of these characteristics and because these scars are unsightly, we feel that they should be excised and replaced by a hair line scar if possible. The defect remaining after excision of the scar is sometimes small enough so that the neighboring skin and subcutaneous tissue can be undermined and closed over the defect without undue tension. Sometimes, however, especially in the tibia, the defect is so large that this is impossible without increasing the tension on the skin edges to such an extent that a slough may occur. It is important to procure a healthy soft tissue covering for the bone. In order to obtain this result it may be necessary to raise a double pedicle flap on the medial aspect of the leg and shift it laterally to cover the exposed portion of the bone completely. The defect on the medial aspect resulting from the shifting of the double pedicle flap is then covered with a split thickness graft. The result in such a case is shown in Figure 6.

SUMMARY

Of 200 consecutive patients with chronic osteomyelitis, 41 had been treated for more than 1 week with an erroneous diagnosis during the acute stage of the process and in only 9 was the bone drained during the first week of the disease.

Consequently, at least 191 of these patients had been treated conservatively or by delayed operation. In this entire series the incidence of secondary bone foci was 25 per cent and the involvement of the neighboring joint was 50 per cent.

By means of the standard surgical procedures and prolonged hospitalization with

adequate after-treatment, it was possible to obtain healing in only 61.3 per cent of 98 cases which we followed for 3 years or longer. In 38.7 per cent of these the sinuses continued to drain or the disease healed and recurred during the period of observation.

In the series of 200 cases we consider our end-results as poor in 35.5 per cent, fair in 28 per cent, good in 25.5 per cent, and unknown in 11 per cent.

We believe that the cure of the disease depends upon the ability of the surgeon to perform an adequate operation and remove all of the infected bone, and that the type of after treatment is relatively unimportant, provided adequate drainage is maintained.

In about 40 per cent of the patients, adequate surgery is not feasible and such patients are practically incurable.

We believe that early diagnosis of acute hematogenous osteomyelitis and prompt drainage of the focus in the bone is the most important factor in the prevention of chronic osteomyelitis with its attendant economic waste and crippling.

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A BACTERIOLOGICAL STUDY OF THE PERITONEAL FLUID IN PERFORATED PEPTIC ULCERS

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PERFORATION of a peptic ulcer with an immediate diffuse contamination of the peritoneal cavity has long been known to be a condition demanding immediate surgical intervention. It has been empirically recognized that the morbidity and mortality in such patients is determined to a large extent not so much by the character of the material which has already accumulated in the peritoneum as by the length of time that this contamination has been present. The recognition of the difference between early chemical peritonitis and the succeeding bacterial peritonitis is not new, but little study has been made of the type of bacterial peritonitis once this complication has occurred.

The literature on the subject is rather brief. Published monographs lead one to believe that such exudates are innocuous in the first hours. Ulrich, Moynihan, and Alexander state that there is no growth in the peritoneal fluid up to 12 and 18 hours; conversely Bruett reports 74 per cent positive cultures following perforations between the sixth and twelfth hours, and 93 per cent positive cultures in patients coming to operation 12 hours or more after perforation.

In a series of collected cases in which the peritoneal fluid following perforated ulcers has been cultured, Judine obtained 89.3 per cent positive cultures in the first 12 hours, and 100 per cent positive cultures in the second 12 hours. He also showed that those patients with sterile cultures had a smooth postoperative course with no complications. The bacterial flora found in his series consisted mostly of streptococci and staphylococci.

Vendt demonstrated bacteria in 77 per cent of his cultures of 16 cases but found few bacteria in each instance. The non-hemolytic streptococcus dominated the picture, occurring in 90 per cent of the positive cases.

Dudgeon and Maybury report a series of 23 cases. Ten of these peritoneal fluids contained diplococci or streptococci. The authors believe that the streptococci found in the peritoneum in cases of gastric and duodenal perforations are derived from the food and have caused infection at the base of the ulcer and in the peritoneum.

In our own experience and that of other clinics (5), the greatest number of casualties and complications are due to a bacterial peritonitis. It has been our belief that a relative prognosis may be made if we could know whether or not organisms are present at the time of operation and, if present, what types.

Before considering our series of perforated peptic ulcers that were studied bacteriologically, a review of the cases of perforated ulcers for the year 1937 at the Cook County Hospital is desirable. Of 652 patients who were treated for peptic ulcer or one of its complications, 76 patients had perforations, of which 43 (56.5 per cent) were duodenal, 26 (34.2 per cent) were gastric, and 2 (2.6 per cent) were gastrojejunal. Five cases of this group were not operated upon.

Patients entering the Cook County Hospital with the diagnosis of perforated peptic ulcer were brought to surgery as soon as they could be adequately prepared. Such preparation consisted of aspiration of the stomach contents by the aid of a Levine tube and continuous suction, the intravenous administration of saline and glucose solution, and morphine and atropine. Thirty-four patients with perforated ulcers that came to operation had cultures made of the peritoneum.

PROCEDURE

Immediately upon the opening of the peritoneal cavity fluid material was aspirated into

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TABLE I.—AGE INCIDENCE

Age in years	Number of cases	Number of deaths
10–20	2	—
21–30	19	1
31–40	21	4
41–50	16	5
51–60	14	5
61–70	3	2
71–80	1	—

TABLE II.—MORTALITY ACCORDING TO LOCATION OF LESION

Location of lesion	Number of cases	Number of deaths	Deaths per cent
Gastrojejunal	2	2	100
Duodenal	43	6	14
Gastric	26	5	19
No operation	5	4	80

TABLE III.—CULTURE RECORD IN 34 CASES

Hours elapsed	Cases	Deaths		Positive culture	
		Number	Per cent	Number	Per cent
0– 6	11	3	27.2	2	18
6–12	8	4	50	6	75
12–18	6	3	50	2	33
18–24	4	2	50	4	100
24–48	4	4	100	3	75
Over 48	1	0	0	1	100
	34	16	46.2	18	52.9

a sterile syringe, placed in a sterile test tube, and transferred to the bacteriology laboratory. Numerous specimens collected were discarded as they had been allowed to stand at room temperature for a length of time sufficient to allow bacteria to be destroyed before they could be placed on a media conducive to growth. Direct smears were not made routinely, as the presence of alimentary débris too frequently made it difficult to identify organisms. The samples were then cultured in the following manner:

Ascitic blood agar media was used to isolate streptococci. This is a 20 per cent ascitic fluid with one half cubic centimeter of blood added to 8 cubic centimeters of meat infusion agar. Several loops of the material to be cultured were added to this media and pour plates were made. These were examined in 24, 48, and 72 hours. The colonies obtained were then stained by Gram's method, and the gram negative colonies were replated on Endos' media. Organisms which were still unidentified were then placed on the various sugar media and a final diagnosis made by their fermentative properties. Anaerobic organisms were sought by making cultures from the original fluid on the ascitic blood agar slants from which oxygen had been absorbed by pyrogallic acid alkali mixture.

TABLE IV.—COURSE IN 6 POSITIVE CULTURE CASES

Case number	Hours elapsed	Location	Organisms	Course
14	8	Duodenum	Bacillus coli	Penetrating 3 days; stormy course
16	12	Pylorus	Bacillus pyocyaneus	Mild course
18	12	Pylorus	Saccharomyces cerevisiæ	Mild
27	20	Pylorus	Streptococcus viridans (colonies few)	Wound infection
28	22	Duodenum	Staphylococcus albus	Wound infection; fistula
34	7 days	Pylorus	Hemolytic bacillus coli	Perforation into lesser omental bursa well walled off

Thirty-four cases with perforations were cultured. Twenty perforations were located in the stomach and 14 in the duodenum. Three (8.8 per cent) of the 34 perforations occurred in women, 2 were located in the duodenum.

The most frequent organisms found were the Bacillus coli and the hemolytic Bacillus coli. Second in frequency was the Streptococcus hemolyticus of both alpha and beta types; next most frequent was the staphylococcus, and in 3 instances anaerobic bacteria were isolated, one of which was of a hemolytic variety. In addition to these 1 Bacillus pyocyaneus and 1 yeast fungus were isolated. Eighteen, or 53 per cent, of the 34 cases had positive cultures. There were 16 deaths among the 34 cases (Table III). Twelve of the 16 deaths were associated with bacteria of a marked pathogenic nature. Six patients with positive cultures recovered as shown in Table IV.

TABLE V.

Case number	Hours from perforation	Location	Hours post-operative to death	Age	Cause of death
5	5	Stomach	18	60	Shock
9	6	Stomach	2	34	Shock
25	18	Duodenum	6	45	Shock
30	28	Duodenum	24	72	Age-shock

All the cases with Bacillus pyocyaneus, yeast infection, and Staphylococcus albus had mild postoperative reactions in spite of wound infections. Of those infected with Bacillus coli, 1 had a 7 day history with perforation into the lesser omental bursa which was well walled off as an abscess and did not contaminate the general peritoneal cavity. The second had Bacillus coli in the free peritoneal cavity and ran a stormy postoperative course with generalized peritonitis, resulting in many weeks' stay in the hospital.

There were 4 deaths in 34 cases in which the patients had sterile cultures. In spite of this fact, the death in each case was prior to 24 hours following operation (Table I).

The majority of positive cultures occurred after the sixth hour of perforation; cultures of Bacillus coli were present in only 2 instances before the twelfth hour. Anaerobic bacteria were found only after the eighteenth hour. Lohr and Clavel believe that the presence of anaerobic organisms are encountered only as secondary invaders. They are usually found in localized abscesses and may arise from neighboring intestinal loops. All patients having cultures containing both streptococci and Bacillus coli died of diffuse peritonitis. The 2 patients with subphrenic abscess who came to postmortem examination had pure cultures of Bacillus coli in great quantities. All the positive cultures of streptococci were found in cases of perforation of the stomach, while Bacilli coli were found in the stomach or in the duodenum, either alone or in combination with staphylococci, streptococci, and anaerobes.

It is interesting to note the marked change in the bacterial flora in the second 6 hours following perforation. The presence of streptococci and Bacillus coli then appear in the peritoneal cavity, and their presence may be explained on the theory of invasion of the upper bowel by organisms normally found only in the lower intestinal tract. The presence of an early "chemical peritonitis" causes a cessation of peristalsis with a concomitant cessation of secretion of hydrochloric acid, thus allowing for a proximal migration of bacteria from the lower bowel. The quantitative acid secretion in the stomach, therefore, may be responsible for the type of organism found. Streptococci and staphylococci are the organisms most sensitive to the presence of acid. The fact that organisms are infrequent in the early hours following perforation accounts for the fact that few of these patients develop a bacterial peritonitis; the more time elapsing following the perforation the more pathogenic the type of organism. Thus, patients having sterile cultures follow an uneventful postoperative course and do not develop complications.

The clinical course and prognosis in perforated ulcer may be determined by the bacteriological flora as is evidenced by the following case:

The patient, a laborer, aged 27 years, entered the hospital with diffuse abdominal pain present for 5 hours. The onset of the pain was sudden and severe in the upper abdomen spreading rapidly to the lower abdomen. There was no previous gastro-intestinal complaint. Physical examination revealed a well nourished young man lying quietly in bed with a rigid abdominal wall, absence of peristaltic sounds and obliteration of liver dullness. Fluoroscopy revealed a large air bubble beneath the diaphragm confirming the diagnosis of perforated peptic ulcer. Operation was performed within 6 hours after the onset of symptoms. A culture was taken upon opening the peritoneal cavity and 1200 cubic centimeters of a turbid fluid was aspirated from the peritoneal cavity and pelvis. The ulcer one half centimeter in diameter with a soft friable margin was closed with linen suture, and the abdomen was closed without drainage. Continuous gastric suction and supportive treatment were instituted after operation. The abdomen began to distend after the twenty-eighth hour in spite of the gastric decompression; temperature rose to 103 degrees. Transfusion of 350 cubic centimeters of blood was given on the second and third postoperative days because of the patient's poor condition. There were no intestinal sounds at any time and the patient became progressively worse in spite of all therapy and died on the fifth postoperative day from a diffuse peritonitis. The bacteriologist reported the presence of streptococci, Bacilli coli and proteus. The diffuse contami-

nation of the peritoneal cavity by such pathogenic organisms in the early hours following perforation offers a poor prognosis and we were cognizant of this fact within 40 hours.

There is no indication for draining those patients who have sterile material in their peritoneal cavities. The significance of a lower mortality rate (22.3 per cent) in the past year at the Cook County Hospital is due to the fact that the majority of patients, namely, 57 of the 76 cases, were operated upon in the first 12 hours after perforation, and in no patient operated upon was there a drain introduced into the peritoneal cavity.

CONCLUSIONS

1. Certain positive cultures from the peritoneal fluid in perforated peptic ulcers offer a prognostic significance as to the clinical course.
2. Cultures taken in the first 6 hours are usually sterile but when positive offer a poor prognosis.
3. The most frequent organisms found are the Bacillus coli and the streptococcus.
4. When cultures are sterile the postoperative course is smooth and the mortality is low.
5. The presence of pathogenic organisms in the cultures is associated clinically with complications, and are directly responsible for the mortality and morbidity.
6. Drainage is indicated only in patients operated upon many hours following perforation, and then this can be construed only as an heroic treatment.

We wish to thank Miss Silka Stocker and Miss Katheryn E. Buck for their technical assistance.

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THE USE OF NEOSYNEPHRINE IN SPINAL ANESTHESIA

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ONE of the difficulties encountered during the administration of spinal anesthesia is the maintenance of a stable level of blood pressure. The drugs commonly used for this purpose are epinephrine and ephedrine. Both produce an increase in heart rate with a tendency to arrhythmia and are stimulants of the central nervous system. Epinephrine when given subcutaneously or preferably into the muscle produces only an evanescent and inconstant rise in blood pressure; administered intravenously the rise in blood pressure may be marked but is transient. Its action on the heart is marked; ventricular fibrillation has been reported after its intravenous use and pulmonary edema may be produced. Ephedrine has a more prolonged and less violent action on the cardiovascular apparatus but similar to epinephrine it increases the heart rate and nervous tension. The well premedicated conscious patient may become "jittery" after its use.

A brief series of spinal anesthesias has been reported by Tovell who used benzedrine for the control of blood pressure. Our interest in the use of neosynephrine as a peripheral vasoconstrictor was aroused by the work of Carl A. Johnson (2, 3) who showed in a series of animal and clinical experiments that the subcutaneous injection of this drug is followed by an increase in blood pressure, a slowing of the heart rate, and that therapeutic doses such as 5 to 10 milligrams did not produce nervousness and anxiety. The previous literature on the subject can be found in his two articles. Johnson did not find any abnormal cardiac mechanism following its repeated use and found it valuable in combating the hypotension in shock and hemorrhage following operations. It occurred to us that if the drug was so effective in raising a low blood pressure, it might be advantageously used in smaller doses as a preventive against the fall in blood pressure following the induction of spinal anesthesia. A preliminary report on our first 50 cases was made in October, 1937 (1). In January, 1938, Lorhan and Oliverio reported a series of 30 cases and concluded that the drug could be repeated without losing its effect but without the toxic phenomena observed with ephedrine. They stated that the action of the drug was rapid and that blood pressure was maintained for at least 30 minutes following its injection. They were impressed with the rate, rhythm, and volume of the pulse after its use.

We are reporting a series of 163 cases of spinal anesthesia administered in conjunction with the use of neosynephrine. For a control series we selected 100 operations done under spinal anesthesia in which ephedrine was used for the control of blood pressure. The neosynephrine group has been subdivided into low and high spinal anesthesias. In 113 low spinal anesthesias the loss of sensation extended to the umbilicus or slightly above; in the 50 high anesthesias the level of the anesthesia was at the costal margin or above in 60 per cent, midway between umbilicus and xyphoid process in 14 per cent, and to the umbilicus in 26 per cent. Every effort was made to select as nearly as possible a similar control group in which we have 50 low and 50 high spinal anesthesias. The anesthetic drugs used and their dosage will be discussed later.

PROCEDURE

Blood pressure and pulse were determined while the patient was in the ward and then again after reaching the operating room. Following the injection of the vasoconstrictor, readings were made every 5 minutes until the operation was completed. Spinal anesthesia was induced within 5 minutes of the injection of neosynephrine or ephedrine; these were injected into the deltoid muscle and the site of injection was not massaged. Excluded from

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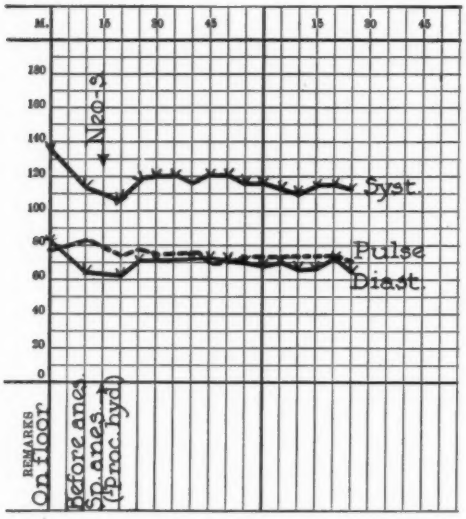
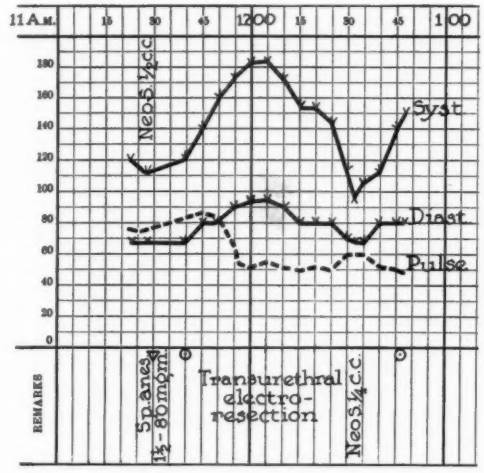
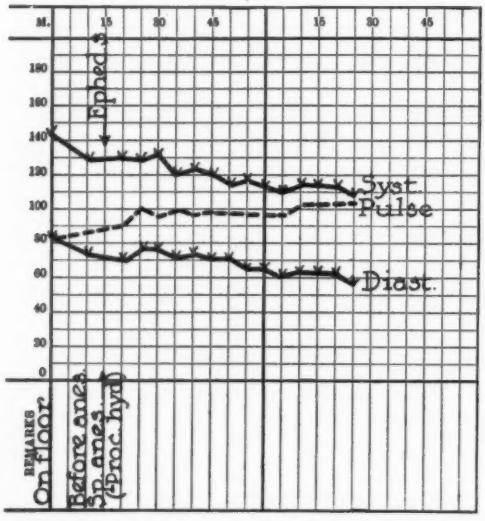


Graph 1. Average curves of systolic and diastolic blood pressures and pulse rates in 113 cases under low spinal anesthesia with procaine hydrochloride. Five-tenths cubic centimeter of 1 per cent solution of neosynephrine was given subcutaneously 5 minutes before the intraspinal injection. The level of all 3 curves is well maintained.



Graph 2. Blood pressure and pulse record of a patient undergoing transurethral resection of the prostate. Circles indicate beginning and end of operation. Note the marked rise in systolic with the moderate rise in diastolic blood pressures, together with a slowing of the pulse after injection of one-half cubic centimeter neosynephrine. A second dose of a small amount of neosynephrine (one-fourth cubic centimeter) is quite effective. Such large responses are sometimes seen; the pressor response here lasted 45 minutes.

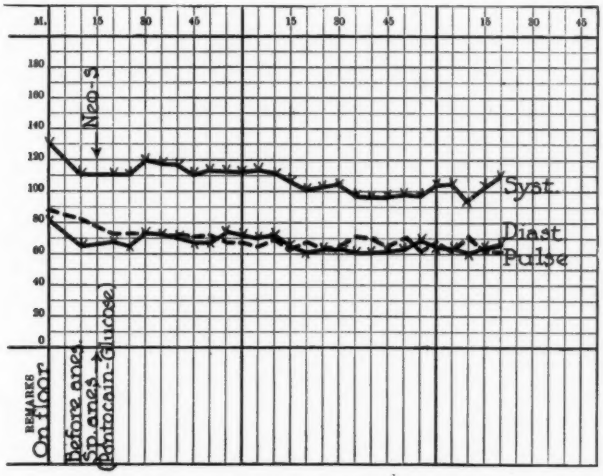


Graph 3. Average curves of blood pressure and pulse in 50 cases under low spinal anesthesia. Every effort was made to make this control series comparable to the one shown on the first graph. Three-fourths grain of ephedrine was used instead of neosynephrine. Note that the blood pressure shows a gradual fall and the pulse rate rises.

our statistics were patients who had complications during operation such as hemorrhage; in the presence of marked hypertension, neosynephrine was not administered except when a fall in blood pressure occurred. In order to stabilize blood pressure as much as possible a second dose of neosynephrine was given as soon as the blood pressure began to drop. The interval between 2 injections ranged from 10 minutes to 1 hour and 15 minutes, the majority of them being within 30 minutes after the first dose.

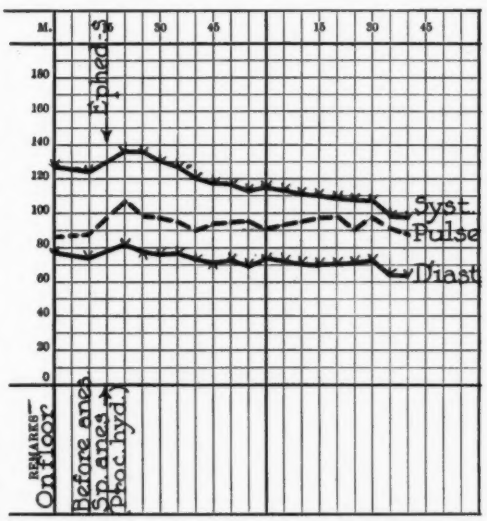
RESULTS

In the first group of 113 cases in which low spinal anesthesia was induced and neosynephrine was used to control the blood pressure, the average dose of procaine crystals was 97 milligrams in 2 cubic centimeters of spinal fluid. The maximum dose was 200 milligrams in 3.5 cubic centimeters and the minimum dose was 50 milligrams in 2 cubic centimeters of spinal fluid. Graph 1 shows the average systolic and diastolic blood pressures and the

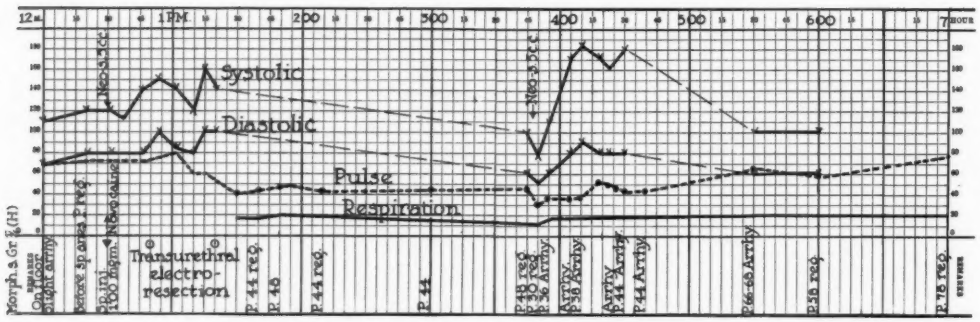


Graph 4. Average curves of blood pressure and pulse in 50 cases under high spinal anesthesia using neosynephrine with pontocaine in 10 per cent glucose solution. The average duration of anesthesia was 2 hours and 15 minutes. The stability of the curves is impressive after the use of neosynephrine.

heart rate. Neosynephrine was given in doses of 0.5 cubic centimeter of a 1 per cent solution; in 15 cases it was repeated again and in 1 case 3 injections were given. It will be noted that the average systolic pressures did not vary over 12 points and the average diastolic pressures over 10 points. The average pulse rate was maintained below 80 but not lower than 70 beats a minute. One would get a false impression, however, by looking at only the average curves in regard to marked fluctuations of blood pressure under spinal anesthesia and the ability of neosynephrine to control them. In Graph 2 one can see the marked pressor response to the first dose of neosynephrine which, however, wore off in 30 minutes when the pulse pressure became small. The small pulse pressure is often the earliest sign of shock, but a small dose (0.25 cubic centimeter) of neosynephrine promptly restored the systolic blood pressure. Note also the marked bradycardia, the pulse rate ranging around 50 for at least 45 minutes. In such cases added to the hypotensive effect of the spinal anesthesia, one has to consider the effect of hemorrhage and shock, both of which may be compensated within limits by vasoconstriction (3).

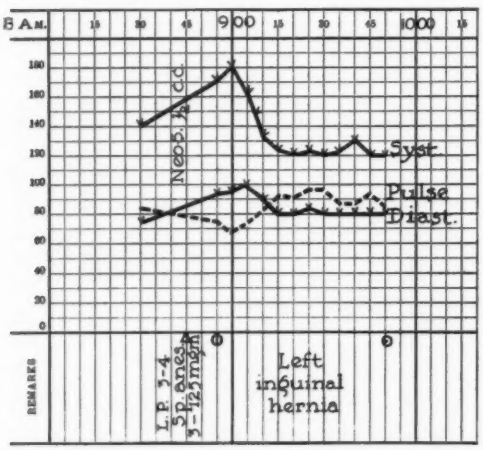


Graph 5. Average curves of blood pressure and pulse in 50 cases under high spinal anesthesia using ephedrine with procaine hydrochloride. The average duration of anesthesia was 1 hour and 40 minutes. Both systolic and diastolic pressure gradually drop. The pulse rate is well stabilized. Since these records were obtained several years ago before pontocaine-glucose was available, they are not ideal as controls to compare with Graph 4. However, pontocaine-glucose produces a long anesthesia and thus constitutes a more severe test for neosynephrine.



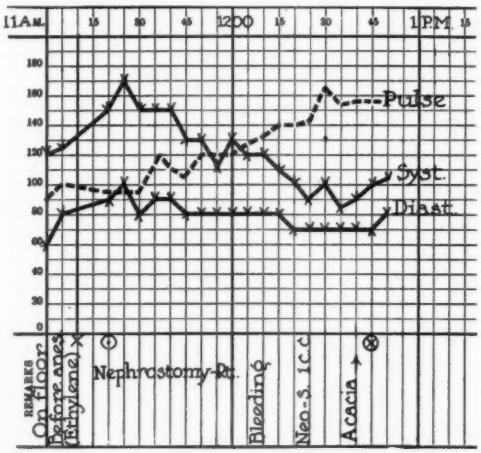
Graph 6. Blood pressures and pulse rates of a patient during and for 5 hours after spinal anesthesia. Following the return of the patient to bed a bradycardia between 44 and 48 continued for over 2 hours. The pulse, however, was regular. When the blood pressure fell to 75/50 another 0.5 cubic centimeter of neosynephrine was given which resulted in a prompt pressor response; the pulse fell as low as to 30 and later varied between 38 and 66 beats per minute. There was an arrhythmia for 2 hours. While no electrocardiogram is available during this bradycardia with arrhythmia, the probability of a partial heart block is high.

The rise in blood pressure occurred on the average within 10 minutes following the injection of neosynephrine. Within this limit 27 per cent of the cases showed a rise of 20 points or more of the systolic blood pressure, while in some cases no rise occurred after the first dose. The lack of rise, of course, does not indicate that the drug was ineffective, as it is really given to prevent a fall which so often accompanies spinal anesthesia.

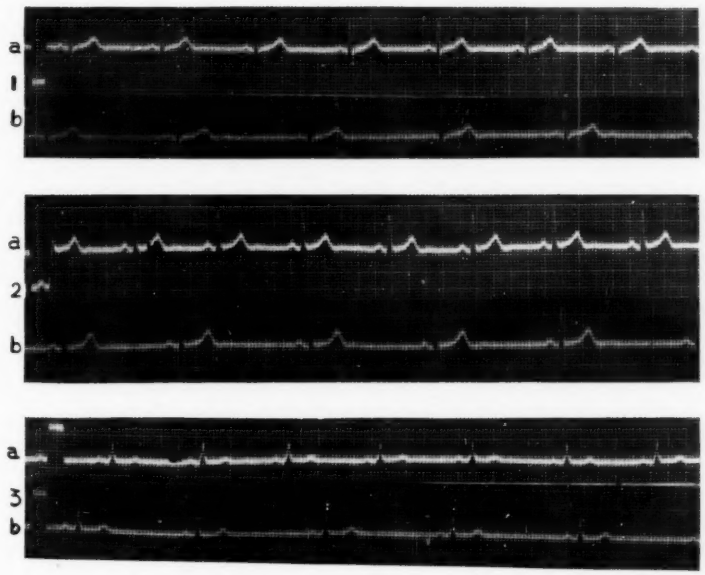


Graph 7. This patient shows a good pressor response with a slight bradycardia, which seems to last just as long as the hypertension. Such observations may be duplicated many times and would suggest that the bradycardia is a reflex response to the rise in blood pressure such as occurs when closing an arteriovenous fistula (Branham's sign).

A control series of 50 patients had been given a low spinal anesthesia with ephedrine as the vasomotor stimulant. While every attempt was made to select a comparable series, this is possible only within limits. Thus, while all these patients had an anesthesia at



Graph 8. This patient underwent a nephrostomy under general anesthesia. Severe bleeding occurred followed by a fall in blood pressure to 90/70. The pulse rose from an initial rate of 90 to 140. One cubic centimeter of neosynephrine failed to raise the blood pressure, although it might have prevented a further fall, and the pulse rate rose to 160. Restoration of blood volume with acacia raised the blood pressure slightly. This graph is presented to illustrate that when hypotension is due to loss of circulating blood volume, the drug is not as dependable as when a pure vasomotor palsy is present.

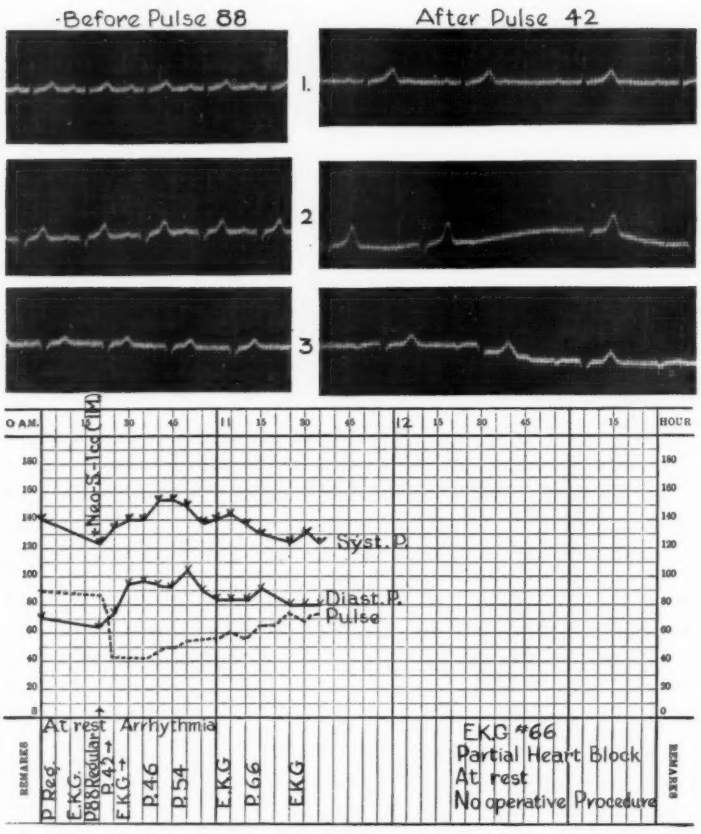


Graph 9. Electrocardiogram (a, before injection; b, after) of a patient with a normal cardiovascular apparatus before and after the administration of 1 cubic centimeter of a 1 per cent solution of neosynephrine. The pulse rate dropped to 40 from 58; a simple bradycardia resulted from the injection.

the level of the umbilicus or below it, the average dose of procaine was higher than in the first group, namely, 125 milligrams. The maximum dose, however, was lower, only 150 milligrams and the minimum dose given was 80 milligrams of crystalline procaine. Ephedrine sulphate was administered in a dose of 50 milligrams (three-fourths grain). It was repeated in 2 cases. Both systolic and diastolic pressures show a gradual fall, 22 points in the systolic and 20 points in the diastolic average pressures (Graph 3). The average pulse rate in contrast to the first series shows a definite rise; it ranged between 95 and 105 beats a minute during the course of operation.

In another series of 50 patients, high spinal anesthesias were studied with neosynephrine and compared with another 50 cases in which ephedrine was employed. These 2 groups are again not strictly comparable, as in the neosynephrine group pontocaine in 10 per cent glucose was the spinal anesthetic, whereas in the control group, which was selected from the material of previous years, crystalline procaine was used. However, the level of anesthesia was just as high in the control series and it is permissible to assume that the fall in blood pressure is commensurate with the level of vasoconstrictor paralysis. In addition, the pontocaine-glucose anesthesia lasts so much longer than the procaine anesthesia that neosynephrine has been put to a more severe test in this group than it has been in the controls.

Graph 4 shows the average figures of 50 cases. The average dose of pontocaine was 17 milligrams, individual doses ranging from 20 milligrams in 3.5 cubic centimeters to 10 milligrams in 1 cubic centimeter of 10 per cent glucose. Readings were continued for 2 hours and 5 minutes, although individual cases had even longer operations under effective anesthesia. The curves show a satisfactory leveling of blood pressures and pulse rates within this period. Again the average pulse did not go above 73 nor drop below 60 beats per minute. The lowest average reading of blood pressure was 92/60.



Graph 10. Electrocardiogram, blood pressure curve and pulse rate following the injection of 1 cubic centimeter of a 1 per cent solution of neosynephrine. The pulse dropped to 42 and 38. With a pulse rate of 42, a partial heart block developed which was present also in a subsequent tracing taken 45 minutes after the injection. A last tracing taken an hour after the injection showed a normal rhythm. There were no symptoms in the patient's past history which would be indicative of myocardial disease.

Comparing these figures with the ones obtained in the control group, in which ephedrine was used for maintenance of blood pressure, one notes that the average duration of anesthesia is shorter and yet the tendency for both systolic and diastolic pressures to drop is more pronounced as is shown in Graph 5. The average dose of procaine was 202.5 milligrams in 2.4 cubic centimeters of spinal fluid, ranging from a maximum of 300 milligrams in 5 cubic centimeters to a minimum dose of 150 milligrams in 1 cubic centimeter of spinal fluid. The dosage of ephedrine was 1.5 grains in 10 cases, 1 grain in 1 case and three-fourths grain in the remaining 30 cases.

The average pulse rate is again higher here than in the neosynephrine series. The bradycardia following the administration of neosynephrine is a striking phenomenon. It outlasts the temporary rise in blood pressure. In Graph 6 the bradycardia continued after the patient had been returned to his bed and varied between 44 and 48 for over 2 hours. Following a second dose of neosynephrine which was given because of a fall in blood pressure to 80 systolic and 55 diastolic, the

pulse rate became as low as 30 beats per minute and a marked arrhythmia developed and persisted for 2 hours. It is interesting to note that this patient had an arrhythmia on the floor before coming to the operating room. To illustrate, however, that this bradycardia is not always of as long duration, we show the curves obtained in a patient with an inguinal hernia (Graph 7). In this case the bradycardia, which was not pronounced, lasted exactly the length of time which the hypertension did. In case of profuse hemorrhage, however, neosynephrine may not raise blood pressure or produce a bradycardia. In Graph 8 a nephrostomy was done under general anesthesia. When severe bleeding occurred and the blood pressure fell, neosynephrine did not produce a rise although it may have prevented a further fall; the pulse kept climbing up. Restoration of blood volume with acacia effected a prompt rise in blood pressure.

EVALUATION OF STUDY

Our experience with neosynephrine, as shown in the graphs presented, shows that it is capable of stabilizing blood pressure in spinal anesthesia in the majority of cases whether the anesthesia is low or high, or of short or long duration. As the acute hypotension during spinal anesthesia is of vasomotor origin, it is to be expected that a drug which has a marked peripheral vasoconstrictor action would be suitable for the maintenance of blood pressure. It definitely lacks the action of epinephrine and ephedrine on the central nervous system and does not increase the irritability of the patients who are in a conscious state under spinal anesthesia.

It can also be said that if the hypotension is due only to a vasomotor palsy but not to a sudden loss of circulating blood volume the drug can be depended on to restore blood pressure to a safe level. As a matter of fact the drug should really be given more for prevention of hypotension than for restoration of the blood pressure. It has been our custom to give the first dose just before the induction of spinal anesthesia and give the second dose when the blood pressure begins to drop, which is usually around 30 minutes following the induction of the spinal anesthetic.

Beside the hypertensive action of the drug a slowing of the heart occurred to 48 beats or below in 11 per cent of 163 cases. One might at first consider this as due to the pressor-receptors in the vascular system which respond with a vagal slowing of the heart whenever systemic or pulmonary pressure rises. This is a useful mechanism and has a sparing action on the heart. But as shown in Graph 6 the bradycardia outlasted the hypertension for several hours. The pulse rate dropped as low as 30 and varied mostly between 48 and 42. This and a few other observations prompted us to investigate this bradycardia more closely. Johnson has pointed out that this is a simple bradycardia and we found this to be so in a few experiments in which electrocardiographic tracings have been made before and after the use of the drug (Graph 9). That one can produce a partial heart block with neosynephrine is illustrated in the case of E. S., a patient with an atypical hyperthyroidism and a high unstable vegetative nervous system, whose electrocardiographic record would indicate that a partial heart block had been produced with 1 cubic centimeter of 1 per cent neosynephrine (Graph 10). This observation and the one recorded on Graph 6 would indicate (1) that, in patients with advanced age and slow pulse or evidence of myocardial damage, the drug be used with great caution, preferably with atropine; (2) that doses of 0.5 cubic centimeter be not exceeded for 1 injection, but repeated injections are permissible. However, we do not wish to create the impression that any untoward cardiac symptoms are to be expected from 0.5 cubic centimeter doses. To illustrate the tolerance of some patients to this drug the case of a patient who received 1 cubic centimeter of a 1 per cent solution of neosynephrine intravenously by mistake may be cited. Outside of a violent headache and palpitation no damage resulted from this error.

A further study of neosynephrine on the heart with electrocardiograms and measurements of cardiac output is now under way. As a persistent heart rate at rest below 50 is always suspicious of a heart block (4), we intend to exclude such patients from the use of neosynephrine until more is known about

the action of this drug on the heart. While a pre-operative electrocardiogram often would be desirable, its routine use on large surgical services is not feasible at present, nor is the clinical significance of some abnormal electrocardiographic findings certain enough to deny some of these patients the benefit of surgical relief. This is especially true of the group suffering from prostatic obstruction.

SUMMARY AND CONCLUSIONS

In a series of 163 patients who were given a spinal anesthesia, neosynephrine was used in a single or repeated dose to stabilize blood pressure. In a control series of 100 patients ephedrine was employed for the same purpose. It was found that neosynephrine could be depended upon to raise or maintain a falling blood pressure at least as effectively as ephedrine, but it lacked the stimulating effect of ephedrine on the central nervous system which is a distinct advantage. Also instead of producing a tachycardia, as epinephrine and ephedrine do, a bradycardia was quite apparent. The finding of this bradycardia has led to a warning in patients suffering from myocardial damage and especially those in whom partial heart block is suspected. In the group, however, which contained many bad risks, no untoward reactions have been produced.

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KNEE JOINT TUBERCULOSIS

Two Hundred Twenty-Two Patients Treated by Operative Fusion

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FUSION of the knee joint has not yet been universally accepted, especially the use of this procedure in children. It is, therefore, considered advisable to present this large series consisting of all the cases of knee joint tuberculosis operated upon at the New York Orthopedic Hospital from September, 1915, through December, 1936. Knee fusion was performed in 222 cases during this period. One hundred and ninety-nine cases have been followed 1 year or more, and these patients form the group for end-result study.

DIAGNOSIS

The diagnosis is not difficult in late cases which often have a suggestive appearance. Flexion deformity, synovial thickening, marked atrophy of the thigh and calf, with slight heat and tenderness at the joint, form a typical group of physical signs to which sinus formation is frequently added. In the early cases, the diagnosis is not so evident. Persistent, unilateral, synovial thickening or effusion at the knee, raises the question of tuberculosis; and it has been our experience at this hospital for many years that this question cannot be satisfactorily answered except by exploration of the joint, thereby verifying the diagnosis by laboratory methods. Tuberculosis may be present even though it is not found by aspiration and guinea pig inoculation.

The most usual history is one of chronic swelling of the knee with gradual onset. A history of injury was given in 60 of the entire series of 222 cases. It is difficult to evaluate this factor. Frequently trauma is slight and the symptoms do not appear until many months after the injury.

In 146 cases of the series the diagnosis was proved by the finding of tubercles in the sections of pathological material taken from the knee joint, by guinea pig inoculation of this material, or by both. Thirty-two cases were negative. It is our practice to take from each joint opened, tissue for frozen sections, tissue for permanent sections, and tissue and joint fluid for culture. We advocate the inoculation of 2 guinea pigs in each case, as we have found that a number of pigs died of causes other than tuberculosis before the allotted 3 weeks prior to autopsy. The 32 unproved cases were included in the series because of the history, physical, and operative findings. It is sometimes difficult for the surgeon to select fragments of tissue which contain tubercles for examination, even when the process is active and extensive. Tubercles are more frequently found in the synovial layer than elsewhere in the joint. Many of the unproved cases are those of long duration in which patients have had years of conservative treatment prior to operation. Their course has been typical of tuberculosis, the majority having had sinuses in the past. At operation, there is found much fibrosis, marked destruction of cartilage, and usually erosion of bone.

From the New York Orthopedic Dispensary and Hospital.

SYMPTOMS AND SIGNS IN EARLY CASES

Seventy-nine cases entered the clinic for treatment 1 year or less following the onset of symptoms and form an interesting group of early cases. The most common presenting complaint among these individuals was swelling at the knee, the next was pain, and the next, stiffness. A limp, though it must have been present early, was not noted as a rule. The shortest period in which medical aid had been sought after the onset was 3 days.

In the dispensary examination of these early patients, physical signs were noted in the following frequency: swelling, 67; flexion deformity, 43; spasm, 37; effusion, 30; increased heat, 19; atrophy, 12; tenderness, 9; sinuses, 3. In every case one or more definite physical signs were present. In all these early cases the legs were of equal length.

PRE-OPERATIVE TREATMENT

Many of the patients in this series had been treated conservatively for years. In the entire series the average duration of symptoms before operation was 6½ years, and there were 18 patients who had had symptoms for 15 to 48 years. There were 24 patients who were treated conservatively at the Country Branch of the New York Orthopedic Hospital at White Plains, New York, for a period of from 1 to 10 years (median, 4 years); and in addition, 31 patients who had been under our treatment at the dispensary from 1 to 19 years (median, 5 years). This forms a group of 54 cases, in which certainly a fair trial of conservative treatment had been made, and yet the condition was not arrested by this treatment, or else, there was finally presented an inactive joint so deformed by disease that it was unfit for weight-bearing. How much better it would have been had these patients with distorted useless joints come to operative fusion early instead of undergoing long years of disability, meanwhile harboring a potentially dangerous focus of tuberculosis. At the Country Branch Hospital every effort was made to improve the general health of these patients. They were treated by rest and plaster when the condition was acute; and in the chronic stage walking with a brace was allowed. A long leg brace was used, with a steel upright on either side and leather backing behind the knee, and in some cases behind the entire leg which was snugly bandaged against the leather. The brace was attached to the shoe or to an inner foot plate and lateral joints permitted ankle motion.

It has become our practice to explore the knee by operation, as soon as the diagnosis of tuberculosis is suspected, either to rule out that disease by laboratory examination, or to fuse the joint if the frozen section is positive. These cases are unselected except for a few in which fusion was not performed because the patient's condition obviously did not warrant the operation.

LABORATORY DIAGNOSIS

It cannot be said that frozen section is entirely reliable, as there were 5 cases in which the frozen section was negative, whereas the additional permanent sections were positive, thus necessitating arthrodesis at a second procedure. In 11 cases the sections were positive while the guinea pig, inoculated with material from the same knee at the same time, was negative. In 2 cases the sections were negative while reaction in the pig was positive for tuberculosis. In 2 instances an inoculated pig developed tuberculosis, while a second pig inoculated with the same material from the same knee was negative.

A Mantoux or von Pirquet test was reported in 154 cases. In 2 of these cases the von Pirquet test was negative. One case was proved by section and pig, while the sections in the other case, which was a chronic one of long duration, were negative.

In 116 cases, white blood and differential counts were taken shortly before fusion. In half the cases, which were children under 12 years of age, the lowest white count was 3,500, the highest 14,000, and the average 9,000. The other half were patients over 12 years old, and among them the lowest white count was 4,800, the highest 17,000, and the average 9,500. In the younger group the polymorphonuclear leucocytes ranged from 35 to 83 per cent, the average 52 per cent. In the older group this varied from 44 to 87 per cent with an average of 69 per cent.

A Wassermann, Kahn, or Klein test was done on the blood of 146 patients Four had plus 4 Wassermann reactions. Fusion occurred in all 4 syphilitic cases in from 8 to 17 months after operation.

Red blood counts and hemoglobin determinations were made in 93 cases before fusion. The lowest red count was 3,300,000, the highest 5,900,000, and the average 4,500,000. The percentage of hemoglobin varied from 50 to 100 per cent, and the average was 77 per cent.

X-RAY FINDINGS

Forty-three cases had x-ray films taken 1 year or less after the onset of symptoms, and these form a group for the study of early x-ray changes in this condition. The most common finding was effusion or synovial thickening which was seen in 31 instances. Thin joint space and decalcification were each present in 18 cases, and overdevelopment of the epiph-

yses was often present. There was x-ray evidence of bone erosion in 5 cases.

In later stages progressive thinning of cartilage, bone erosion, and a transparent haziness of the bone shadow make the roentgenographic diagnosis less difficult. The most usual conditions to be confused with early tuberculosis are gonococcus arthritis, and arthritis of the rheumatoid type. Early acute suppurative arthritis may also give the x-ray appearance of tuberculosis though clinical differentiation should be easy.

PRE-OPERATIVE EXAMINATION

In this series there were 130 males and 92 females. The ages at the onset of symptoms were distributed from 6 months to 61 years and were grouped as shown in Table I.

TABLE I.—AGE AT ONSET

Age in years	No. of cases
Under 10	127
10–19	44
20–29	27
30 and over	25

The ages at the time of fusion varied from 2½ to 62 years, and were grouped correspondingly as in Table II.

TABLE II.—AGES AT TIME OF FUSION

Age in years	No. of cases
Under 10	60
10–19	73
20–29	43
30 and over	47

The usual findings before operation were swelling, limitation of motion, spasm, and atrophy of the thigh and calf. Increased heat and effusion were less commonly present. In several instances an effusion was noted which was found to consist of greatly thickened, soft, boggy, synovial lining at operation.

Measurements before fusion were recorded in 153 cases. There was shortening of the affected extremity in 62 cases, lengthening in 30 cases, and the legs were of equal length in 61 cases. Shortening was present up to 3 inches. The median was 1 inch. In the cases with lengthening of the involved extremity the maximum was 1 inch and the median one-half inch.

The position of maximum extension was noted in the pre-operative examination of 180 patients. The most severe flexion deformity was 55 degrees and the average was 20 degrees. In 21 cases complete extension was present.

Actively draining sinuses were present at the time of the fusion operation in 15 cases. In 25 other cases actively draining sinuses previously present had healed at the time of operation.

A record of tonsil examination was made in 159 cases. The tonsils appeared negative in 74 cases and inflamed or hypertrophied in 41 cases. In 41 additional cases tonsillectomy was done before operation and soon after fusion in 3 cases. Microscopic sections of tonsil tissue were examined in 15 of these cases. In 5 patients tuberculosis was found and in the 10 remaining the reactions were negative. In our opinion tonsils which do not appear normal should be removed before the fusion operation, thereby eliminating a possible focus of tuberculosis.

At examination before operation physical signs of active pulmonary tuberculosis were present in 14 cases and there were signs of inactive pulmonary tuberculosis in 4 cases. Fifty-one chest roentgenograms were taken before operation. Evidences of active pulmonary or hilus tuberculosis were present in 21, 10 had healed lesions, and 20 were negative. Other complications noted before operation are as follows:

TABLE III.—COMPLICATIONS

Complication	No. of cases
Tuberculosis of hip	5
Tuberculosis of spine	9
Tuberculosis of ankle	2
Tuberculosis of wrist	1
Tuberculosis of tarsus	1
Multiple soft tissue tuberculous abscesses	1
Tuberculous cervical adenitis	1
Tuberculosis of kidney	3
Tuberculosis of sternum	1
Tuberculosis of testes	1
Syphilis	4
Gonorrhea	1

DECLINING INCIDENCE

The most encouraging aspect of knee joint tuberculosis, apart from the success of arthrodesis, is its declining incidence. This is also

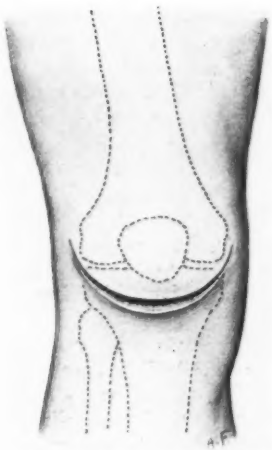

Fig. 1. Incision for arthrodesis of knee joint.

true of the general incidence of joint tuberculosis. In the 5 year period, 1921 through 1925, an average of 15 knee fusions for tuberculosis were performed at this hospital each year. In comparison, during the 5 year period, 1932 through 1936, the yearly average was but 5 knee fusion cases.

OPERATION ON KNEE PREVIOUS TO FUSION

Aspiration for diagnosis was done at this hospital on 16 knees, and the fluid was used for guinea pig inoculation. The pigs were positive in 8 cases and negative in 8. Six of the 8 cases with negative aspirations were proved tuberculous at subsequent operation. A negative aspiration, therefore, does not rule out tuberculosis, and this procedure should be reserved for cases in which operation must be delayed.

Exploratory arthrotomy was performed in 17 cases previous to fusion, and the diagnosis of tuberculosis was verified by laboratory findings. In 4 other cases synovectomy was done because the frozen section was negative, though the final report on the permanent sections was positive for tuberculosis. Three additional synovectomies were done with a pre-operative diagnosis of chronic arthritis, the final sections proving the condition to be tuberculosis. Incision and drainage and synovectomy were performed in 4 secondarily infected cases, and 2 cases had a tuberculous bone abscess close to the joint which was explored before fusion.

Twenty-four additional operations were performed at other hospitals on 19 patients before fusion. These procedures included arthrotomy, resection, synovectomy, incision and drainage, excision of meniscus, aspiration, and attempted arthrodesis.

FUSION OPERATION

Arthrodesis was performed in all cases, essentially in the manner described by Russell A. Hibbs in 1911, who first used this procedure in cases of poliomyelitis. According to the present technique, the knee is widely exposed through a U-shaped incision, from the medial aspect of the joint at the femoral condyle, curving to bisect the ligamentum patellæ, to a corresponding point on the lateral aspect of the joint. The medial limb of the U is made first, and the joint exposed through it for frozen section. The menisci are removed together with the articular cartilage from the femur and tibia to secure direct bone contact between them. The patella is denuded of cartilage and periosteum, and it is placed in the slots prepared for it without changing its axis. In some cases a portion of the periosteum on the anterior surface of the patella is left attached.

Formerly, the wound was closed with chromic suture for the skin, though recently silk has been used in preference. In 2 cases the patella was diseased so extensively that it could not be employed in the mortice, and in 2 children the bony portion of the patella consisted of a very minute fragment. In 7 cases the patella was found to be formed entirely of cartilage, and in 2 of the cases the patella could not be used. In 5 cases the wound was drained because of secondary infection from open sinus tracts. The operations in this series were performed by 30 different surgeons.

Once the closure has been completed a dry dressing is placed on the wound. The joint is then surrounded with a layer of cotton, care being taken to protect the peroneal nerve at the fibular head. Sheet wadding and paper are applied, and then the single plaster spica extending from the toes to above the lower

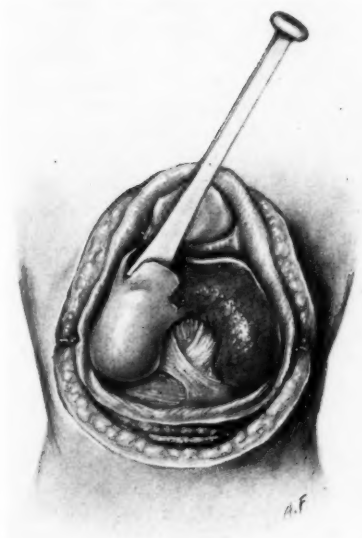

Fig. 2. Removal of articular cartilage from femur.

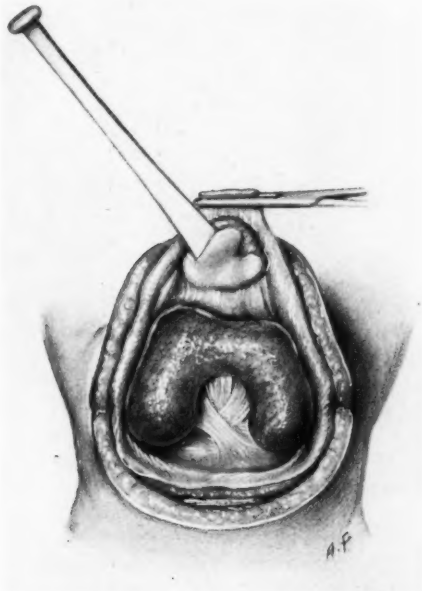

Fig. 3. Removal of articular cartilage from patella.

costal margin. Adult knees are put up in 10 degrees' flexion as the gait is better in that position, while those of children are placed in 180 degrees' extension to prevent strain on the lower femoral epiphysis.

Since 1928 ethylene has been the routine anesthetic for these cases; previously gas-ether was used. Ethylene has been employed in 58 cases, gas-ether in 161, and spinal in 3. In no case has pulmonary tuberculosis flared up after operation whether gas-ether or ethylene was employed. A tourniquet is used during operation, the leg being first emptied of blood by a spiral Esmarch rubber bandage.

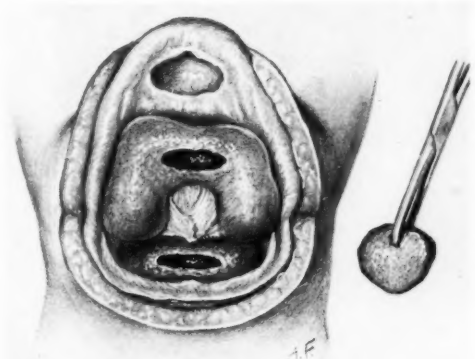

Fig. 4. Patella has been enucleated, and tibial articular cartilage has been removed. Slots have been made in femur and tibia to receive patella.

Fig. 5. Patella has been placed in prepared slots.

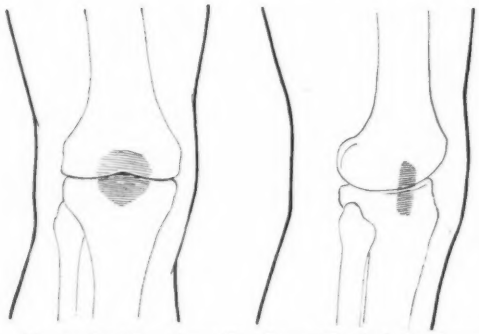

Fig. 6. Position of patella when arthrodesis has been completed. Bony contact has been secured between femur and tibia.

Five cases died within 1 year after operation. Three of these died of tuberculous meningitis, 1 of pulmonary tuberculosis, and 1 of renal tuberculosis.

PATHOLOGICAL FINDINGS

Thirty-four patients were operated upon at the New York Orthopedic Hospital within 1 year after onset of symptoms, and in 32 of these tuberculosis was proved by sections or inoculation of pigs. These cases were significant because of the early pathological changes. According to the operative findings, the synovial layer was involved in all these cases and was found to be thickened in 30 cases. The synovial membrane was red or gray in color, and in 7 cases was described as "gelatinous." An excess of turbid fluid was present in 5 cases and a serous effusion in 6. Three joints contained thick pus. The cartilage was eroded in 15 cases and usually was partially covered with pannus before erosion. Bone destruction was present in 7 cases. In every case but 1 it appeared that the synovial layer was the primary site of the disease.

Thus in the earliest cases a moderate thickening and reddening of the synovial layer are all that is seen. There may or may not be a serous effusion. In these cases there is often pannus formation on the joint cartilage where it does not directly articulate. Later this may extend over the articular portions. As the synovial lining becomes more necrotic the color changes to gray and its appearance has been described frequently by surgeons as "edematous." This edematous or gelatinous

Fig. 7. W. J. Proved tuberculosis of knee joint. Fusion was performed at age of 5, 6 years before this roentgenogram was taken.

Fig. 8. J. E. Proved tuberculosis of knee joint. Fusion was performed at age of 12 years, 7 years before this roentgenogram was taken.

material may become abundant in the joint. Thinning of the cartilage to the extent of perforation is a later change. The cartilage seems more resistant than the bone to destruction, as not uncommonly a small perforation through the cartilage becomes the mouth of a large cavity in the bone beneath. However, in 3 cases in the entire series the joint unquestionably became involved secondarily by direct extension from a tuberculous bone abscess. Areas of caseation are found only in advanced cases.

POSTOPERATIVE CARE

Two weeks after operation the plaster is fenestrated over the operative wound for inspection and suture removal. The case is then transferred by ambulance to the Country Branch Hospital at White Plains for convalescent care. Eight weeks after the fusion operation the spica is removed, an x-ray is taken, and a long leg plaster is applied from toes to groin in which the patient is allowed to walk. Following this the plaster is changed at 8 week intervals with an x-ray examination after each removal until the fusion is solid. Then the cast is left off and the patient is allowed to walk without protection. Children, however, at this stage are given a long leg brace to prevent slipping of the lower femoral epiphysis. Twenty-eight children wore braces after the plaster was removed for an average period of 8 months. Experience has shown that in some cases slipping of the lower femoral epiphysis has occurred which probably could have been prevented by the use of a brace. Epiphyseal slipping, a troublesome postoperative complication, occurred after operation in only 3 children over 10, and in each instance this was because the knee was not put up straight at the time of operation.

OCCURRENCE OF FUSION

Cases have been kept in plaster from 2 to 42 months postoperatively. The average time was 8 months. The plaster is left on in most cases until the arthrodesis is solid. Therefore, this is a measure of the time elapsed in securing fusion. A few cases with extremely active disease and many sinuses have been kept in bed longer than the 8 weeks' routine period of bed rest before weight bearing was allowed.

END-RESULTS

Of the 222 cases in which the knee fusion operation was performed, 5 died within 1 year after operation, and 18 patients were lost to the follow-up clinic within a year.

One hundred and ninety-nine cases thus remained which were followed for more than 1 year after operation and these form the group for end-result study. Every one of these 199 knees in the end-result group fused but 3; and these 3 had such hopeless sinuses both before and after the fusion operation that amputation of the leg was finally performed. These 3 patients were living and well at the last examination.

No patient with a follow-up period shorter than 1 year was retained in this series. The longest follow-up period after fusion was 17 years, the average 5½ years. These end-result examinations were made by the staff of the New York Orthopedic Hospital.

Seven of the 199 patients, followed for more than 1 year, are dead; and successful fusion had taken place in each case. (The diagnoses at the time of death in these 7 cases were the following: pneumonia, carcinoma of the uterus, amyloidosis, pulmonary tuberculosis, renal tuberculosis, sarcoma, and unknown in 1 case.)

In the 196 cases which became fused, there was no evidence of either tuberculosis or secondary pyogenic infection remaining at the knee, except in 7 patients who had draining sinuses at the last examination. There are 3 cases now fused in which a refusion operation was performed.

The position in which the knee was arthrodesed at last examination was noted in 142 cases. Eighty-three of these were flexed, 49 were straight, and 10 were in recurvatum. In the flexed group the median amount was 10 degrees, and in the hyperextended cases the median was 10 degrees. Knock knee was present in 19 and the median was 5 degrees. Two cases had a genu varum deformity. Four cases were advised to have osteotomy because of the degree of flexion deformity.

In 93 cases measurements from the anterior superior iliac spine to the medial malleolus were recorded and 76 of these had shortening. The greatest amount of shortening was 5

inches in a patient who had had a resection elsewhere previous to fusion. The average shortening of the 90 cases was 1 inch. In 1 case, the fused leg was one-fourth inch longer than the other.

Slipping lower femoral epiphysis. The most troublesome postoperative complication is the tendency of the lower femoral epiphysis to slip in children up to the age of 14 after fusion has taken place. In 19 children slipping, requiring either closed or open correction, took place between the ages of 3 and 14. Closed stretching under anesthesia was done in 17 cases and repeated in 2 of them. Supracondylar femoral osteotomy was done in 7 cases and osteotomy at the fusion site in 4. Only 1 slipping occurred at the upper tibial epiphysis. At present we believe that this slipping has been overcome by putting up the child's knee in full extension and by the use of a long leg brace in younger children.

Wound healing. Of 140 cases reported, 90 patients had healed wounds and no sinuses at the first plaster change 8 weeks after operation. The 50 remaining had sinus formation in wounds or other locations at that time. However, there were only 15 patients who had sinuses 1 year after fusion. There were 6 wound infections in patients who had no sinuses before operation. In 7 cases sinuses persisted when patients were last seen.

Other complications. Transient tourniquet paralysis was present in several cases before the adoption of the present technique, consisting of the use of an Esmarch elastic bandage to empty the leg of blood. Temporary foot drop, due to pressure of the cast against the peroneal nerve at the fibular head, was present in several cases. Only 1 patient in the entire follow up series was incapacitated by active pulmonary tuberculosis at last examination.

Arthrodesis in very young children. There are 14 patients in the entire series who were 5 years old or less at the time of the fusion operation, the youngest being only 2. Solid bony fusion is present in every case in this group and 6 of these patients have been followed 8 to 14 years since the time of fusion. In patients with marked shortening the epiphyseal lines close to the knee have been implicated by disease before operation. In all early cases some shortening will result due to atrophy. As I believe this to be the only series of fusions in such young patients extant, a brief résumé of each case follows:

CASE J. P. No. 49947, male. Fusion operation was performed at the age of 5 years when tuberculosis was proved. Symptoms were present since the age of 1. It is now 14 years after his operation and he is 19 years old. The knee is solidly fused, but he has 4½ inches of shortening due to the implication of the lower femoral epiphysis by disease destruction.

CASE E. S. No. 82121, male. Fusion operation was performed at the age of 3 years when tuberculosis was proved. Onset of symptoms occurred at the age of 2 years with an abscess of the femoral epiphysis which extended into the joint. It is now 12 years after fusion and patient is 15 years old. The knee is solidly fused in 10 degrees' flexion and shortening measures 2 inches.

CASE C. P. No. 55824, male. Fusion operation took place at the age of 3 years and case remained unproved. Symptoms were present since the age of 1 year. The last examination took place 13 years after operation. The knee was solidly fused in 5 degrees' flexion. Shortening of 3¾ inches was due to the fact that upper tibial epiphysis was partially destroyed before operation.

CASE P. W. No. 85529, female. Fusion operation at the age of 5 years proved presence of tuberculosis. Symptoms had been present for 2 years. It is now 12 years since operation, and patient is 17 years old. There is shortening of 2 inches and complete fusion at 180 degrees' extension.

CASE B. E. No. 93406, female. Fusion operation at the age of 4 years proved presence of tuberculosis. Symptoms had been present for less than 1 year. The patient was followed 3 years. The knee fused in 10 degrees' flexion and the shortening measured ½ inch.

CASE W. T. No. 99536, male. Fusion operation at the age of 5 years proved the presence of tuberculosis. Symptoms were present for 2 years. The patient was followed 4 years. At the last examination fusion was solid in 15 degrees' flexion and the legs were of equal length.

CASE K. L. No. 101147, male. Fusion operation at the age of 2½ years proved tuberculosis. Symptoms were present over 1 year. The patient was last seen 3½ years after operation when he presented solid fusion and 2¼ inches of shortening.

CASE J. F. No. 113910, male. Fusion operation was performed at the age of 2¾ years. Onset occurred at the age of 1 year. Tuberculosis which began in abscess of upper tibial epiphysis and which involved joint secondarily was proved. The patient was last seen 8 years after fusion at which time the knee was fused in 5 degrees of flexion with 1 inch of shortening.

CASE E. M. No. 127438, male. Fusion operation was performed at the age of 4 years when tuberculosis was proved. Symptoms had been present for less than 1 year. The last examination took place 8 years after fusion. The knee was solidly fused with 20 degrees' flexion and 1¾ inches' shortening.

CASE E. D. No. 131477, female. Fusion operation at the age of 4 years proved tuberculosis. Symptoms were present for 1½ years. The last examination took place 6 years after operation at which time shortening was 1¾ inches because the lower femoral epiphysis was implicated by disease.

CASE W. J. No. 141612, male. Fusion operation at the age of 5 years proved tuberculosis. Symptoms were present for 1 year. Seven years after operation the knee was fused in straight alinement with 1¼ inches of shortening.

CASE B. R. No. 143464, female. Fusion operation at the age of 2 years (the youngest case in the entire series) proved tuberculosis. Symptoms were present for 6 months. The patient was last seen 6 years after operation with the knee fused in 5 degrees' flexion and shortened ½ inch.

CASE H. B. No. 152587, male. Fusion operation at the age of 4 years proved tuberculosis. Symptoms were present for 1½ years. The patient was last seen 2 years after operation with ¾ inch shortening. Fusion took place in full extension with slight knock knee.

CASE R. S. No. 184967, male. Fusion operation at the age of 5 years proved tuberculosis. Symptoms were present 7 months. The knee was solidly fused in straight alinement with ¾ inch shortening 2½ years after fusion. The lower femoral epiphyseal line had been destroyed by cavitation before operation.

SUMMARY AND CONCLUSIONS

1. In the period, September, 1915, to December, 1936, knee fusion was performed in 222 cases of knee joint tuberculosis at the New York Orthopedic Dispensary and Hospital.

2. One hundred and ninety-nine of these cases have been followed from 1 to 17 years after operation with an average follow-up period of 5½ years.

3. Fusion occurred in 196, or 98 per cent, of these cases. Fusion took place and plaster was left off at an average period of 8 months after operation. The disease subsided in all but 7 in whom sinuses persisted. In no fused knee did tuberculosis recur.

4. Fifty-nine patients were 10 years of age or less at the time of operation, and 14 were 5 years old or less.

5. Diagnosis, operative technique, and after care are described.

6. The results of arthrodesis in very young children are discussed.

7. On the basis of our 21 year experience with operative arthrodesis of the knee joint for tuberculosis in 222 cases, this procedure is recommended both for children and for adults. In no other joint in the body has such a high percentage of successful fusions been obtained.

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THE PHOSPHATASE DETERMINATION IN THE DIFFERENTIAL DIAGNOSIS OF BONE LESIONS

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THE enzyme phosphatase has been shown to be present in several tissues of the body in varying amounts, being highest under normal conditions in the intestinal mucosa, renal tissue, and in tissue forming new bone (28). Its presence in the intestine is thought to be related to absorption, and in the kidney to excretion of phosphorus. The presence of phosphatase in tissue which is producing new bone is intimately associated with the process of ossification, and it has been suggested by Robison and Soames that the enzyme is the product of young osteoblasts and hypertrophic cartilage cells. Experimental evidence has shown that its function is to hydrolyze the phosphoric esters of the body to render phosphate ions available for incorporation into the chemical structure of bone (27).

Since Robison, in 1923, first indicated the important rôle of phosphatase in the process of ossification, much experimental effort has been expended in defining the occurrence and characteristics of the enzyme. The reports by Kay in 1929 (16) and Roberts in 1930 (25) of quantitative phosphatase determinations on the blood of patients with disturbances of bone introduced this procedure into the clinical study of bone lesions and demonstrated the phosphatase activity of the blood to be especially high in osteitis deformans. The phosphatase activity of the blood was soon examined by others in many types of bone lesions, and elevated values were found in lesions of such diverse nature as rickets, secondary carcinomatous lesions of bone, hyperparathyroidism with bone involvement, and osteogenic sarcoma.

The earlier work on phosphatase was comprehensively reviewed by Kay in 1932 (19). Besides the earlier reports by Kay and Roberts, referred to, additional series of phosphatase determinations on the blood of patients with the bone lesions under consideration here have been reported by Kay (18); Bodansky and Jaffe; Austoni and Coggi; Franseen and McLean; Simmons and Franseen; Pautrat; Woodard, Twombly, and Coley; Gutman, Tyson, and Gutman; and Woodard and Higinbotham. The reader is referred to these publications and to the recent review of plasma phosphatase in disease by Morris and Peden for a more exhaustive bibliography. Bone lesions such as rickets, osteomalacia, osteomyelitis, and fractures, in all of which the phosphatase of the blood has been reported to be increased, have been omitted from individual consideration here, as well as conditions with a non-osseous source of increased phosphatase activity of the blood, as for example, liver damage with or without jaundice.

Certain generalizations can be derived from the contributions to the study of blood phosphatase in relation to its production by the osteoblastic cells. It is clear that any abnormal osteoblastic activity is reflected as an elevated phosphatase activity of the circulating blood, roughly proportional to the extent and intensity of the attempt at ossification. The phosphatase activity of the blood has been found to be increased in such groups of bone lesions as: (1) abnormal or neoplastic proliferation of bone (osteitis deformans, osteogenic sarcoma, myositis ossificans); (2) frustrated attempts at osteogenesis (rickets) with the production of osteoid tissue; and (3) reparative processes accompanying or following inflammatory, traumatic, or neoplastic destruction of the architecture or the continuity of bone (repair of fractures, repair of areas destroyed by osteomyelitis, or repair in areas being destroyed by carcinomatous metastases). This diversity of type among the bone lesions associated with an elevation of the

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phosphatase activity of the circulating blood is also good evidence, first, that this increased activity is not specific for any particular disturbance of bone, and second, that it is the result of the disease rather than its cause. In more slowly reparative or proliferative processes (e.g. osteoma, osteochondroma), the osteoblastic activity is not intense enough to be reflected in the circulating blood. In these cases, the destruction or elimination of the phosphatase present in the circulating blood is perhaps as rapid as its production. Similarly, in purely destructive lesions as, for example, myeloma, the normal level of the phosphatase activity of the blood is at most only very slightly disturbed. This is probably due to the fact that the normal phosphatase content of adult bone is so slight that its liberation in the process of dissolution of the bone does not measurably alter the activity of the circulating blood, and furthermore, reactive osteoblastic activity is practically nil in these lesions. When destructive and reparative processes occur simultaneously, as in carcinomatous metastases in bone, the constructive process alone is reflected in the phosphatase activity of the blood serum or plasma. In tumors without bone or liver involvement the phosphatase activity of the blood is normal.

In an earlier paper (31) we reported a comparative study of the phosphatase activity of the blood and tumor tissues in a series of cases with bone tumors. Our study suggested that the quantitative determination of the phosphatase activity of the blood and tissue was of value in the study of these tumors. Since the publication of the above report, we have had the opportunity to bring the number of our observations to a total of 473 determinations in 202 cases to support our previous findings. The reader is referred to this report and to the paper by Franseen and McLean for detailed accounts of the values obtained in the various groups of bone tumors. We wish now to reaffirm the value of the phosphatase determination in the differential diagnosis of these conditions by reviewing the subject again to include the additional experience gained through our more recent observations together with the observations reported by others. We wish also to indicate how closely the theory of an osteoblastic source of phosphatase is supported in cases with bone tumors, and how the range of phosphatase values may roughly be predicted from the gross and microscopic characteristics of the various types of lesions.

Most of our phosphatase determinations on blood plasma have been made according to a technique closely following that of Kay (17), and described in a previous paper (10). A few of the determinations on blood serum have been made by the Bodansky (6) method by the chemical laboratory of the Massachusetts General Hospital through the courtesy of Dr. Fuller Albright. In a number of cases, the determinations have been made by both methods. We do not favor one or the other method, since we have always found them to corroborate one another within the limits found significant for clinical use.

In normal adults, the phosphatase values for blood are most commonly found between 0.12 and 0.2 Kay units per cubic centimeter of blood plasma, with an average value of about 0.16 units, or, in Bodansky units, 2.5 to 4.0 units per 100 cubic centimeters of blood serum, with an average value of about 2.9 units. When interpreting the results, we have regarded all values in Kay units as normal up to 0.26 units per cubic centimeters of plasma, since we have obtained values up to this level in apparently healthy individuals. In Bodansky units we have regarded 5.0 units per 100 cubic centimeters of serum as the extreme upper limit of normal.

OSTEITIS DEFORMANS

Osteitis deformans was the first disease in which a high phosphatase activity of the blood was demonstrated (16), and a high value has been shown repeatedly to be the rule in well established cases. In most of the cases with this disease the only abnormality found in the blood is the increased phosphatase activity. Roberts (25) and Kay (18) suggested early that a rough proportionality existed between the level of the blood phosphatase activity and the extent of the bone involvement. This has since been confirmed by several investigators (8, 13, 22). Values varying from a normal figure in cases with quiescent monostotic lesions to the highest

values reported for any disease (30 to 40 times normal) have been found in cases of osteitis deformans with polyostotic lesions.

The source of the high phosphatase activity in osteitis deformans appears to lie in the osteoblasts of the osteogenic tissues, for Franseen and McLean have demonstrated a very high phosphatase content of the actively proliferating tissue in the affected calvarium and ilium of an active case which came to autopsy; and Gutman, Tyson, and Gutman (14) have noted that extensive involvement of the skull is almost invariably associated with relatively high phosphatase values in the blood.

The phosphatase level of the blood appears to depend upon the degree of activity and the extent of the disease; and the fact that it may show only minor fluctuations at a high level over a period of years, as Gutman and Gutman have reported, indicates that the disease often may have long periods of sustained activity. The phosphatase level of the blood may recede at times also, and, by following the elevations and recessions of this level, the phosphatase test is found to be of clinical value in assaying the status of the disease at any time in an individual case, or in indicating progress or arrest of the disease in any case followed over a period of time. It may thus serve as an index of the efficacy of any form of treatment employed and may also give an index of the prognosis in the study of an individual case. For example, we have cited (10) two cases in which fluctuations in the phosphatase values were observed at extraordinary high levels over many months. Both patients eventually died of osteogenic sarcoma.

The elevated level of the phosphatase activity of the blood in osteitis deformans is of limited value in corroborating a diagnosis made clinically or roentgenographically. In early monostotic cases, the phosphatase level of the blood may not be elevated; and, unfortunately, in cases in which there may be confusion in differential diagnosis between osteitis deformans, and, for example, osteoplastic carcinomatous metastases, the phosphatase determination will probably be of no assistance, since the phosphatase level is also elevated in this process with which osteitis deformans is perhaps most often confused.

HYPERPARATHYROIDISM WITH BONE INVOLVEMENT

Increased phosphatase values in hyperparathyroidism were first reported by Kay (16) and Hunter in 1929. In a review of this disease in 1934, Albright, Aub, and Bauer showed that the phosphatase level of the blood was proportional to the degree of involvement of the bones and independent of the degree of hyperparathyroidism. Gutman, Tyson, and Gutman have recently collected from the literature 28 cases of hyperparathyroidism with bone changes. The blood phosphatase was found to be increased in every instance from 1¼ to 16 times the normal maximum value.

The phosphatase level, in this disease also, is probably related to osteoblastic activity in the lesions, but we have had no opportunity to examine the phosphatase content of the tissue in the lesions themselves. The fact that the level of the blood phosphatase does not fall immediately after removal of the parathyroid lesion, is to be expected, if we assume that the phosphatase is not produced by the parathyroid adenoma but by the osteoblasts attempting to repair the bone lesions. Under the same tenet it is not remarkable that the level of blood phosphatase activity should even rise somewhat during the acceleration of the osteoblastic activity in the repair process subsequent to the operative removal of the offending adenoma.

As a matter of fact, in one case of their series, Gutman, Tyson, and Gutman noted a fair degree of correlation between the rate of redeposition of bone observed roentgenographically after operation and the level of the serum phosphatase. At biopsy, Albright, Aub, and Bauer found the osteoclasts already to have disappeared from the bone lesions 9 days after removal of a parathyroid adenoma.

It must be clearly recognized that the blood calcium and phosphorus determinations are distinctly of greater value than is the blood phosphatase determination in the study of this disease, since the phosphatase value merely indicates the degree of osteoblastic activity, hence of bone involvement, and not necessarily the degree of parathyroid activity.

Thus, a patient with hyperparathyroidism without bone lesions may have a normal phosphatase level.

MYELOMA

Microscopically, the lesions of myeloma are purely destructive. As might be anticipated from this fact, no phosphatase activity is found in the tissues of the lesions (10), and the phosphatase level of the blood is practically unaltered even in the presence of numerous lesions. It is by virtue of the normality of the blood phosphatase in this disease that the quantitative determination of this enzyme may be of assistance occasionally in differentiating between a case with multiple myelomatous lesions and a case with carcinomatosis of the bones.

All investigators have reported normal levels of blood phosphatase activity in multiple myeloma, or at most a very slight elevation, with the exception of Rowntree, who reports that he has encountered "increased values in several cases." This is contrary to the theoretical expectation from the histological facts and from the demonstrable absence of phosphatase activity in the lesions themselves. When the phosphatase activity is elevated in the presence of multiple bone defects, a suspicion of carcinomatous metastases, hyperparathyroidism, or even lymphoma of bone should be entertained rather than myeloma.

CARCINOMATOUS METASTASES TO BONE

A small but definite phosphatase activity has been demonstrated by Franseen and McLean in the tissues comprising the metastatic carcinomatous lesions in bones; and in spite of the fact that the lesions may appear to be purely destructive roentgenographically, some reactive attempt at repair by the osteoblasts is invariably seen when the lesions are examined histologically. In single lesions the phosphatase activity of the tissues may be too small to be reflected in the level of the blood phosphatase, but when this activity is increased by multiplicity of lesions, there is invariably an elevation of the blood phosphatase level even in cases with the osteolytic type of metastases.

As might be anticipated, the blood phosphatase levels found in cases with carcinomatous metastases vary over a wide range, depending on the type and extent of the metastatic lesions. Theoretically, in the case of osteoplastic metastases, the increased osteoblastic activity should become manifest in the blood phosphatase value earlier, that is, when the lesions are fewer or smaller than in the case of osteolytic lesions. Gutman, Tyson, and Gutman's comparative series demonstrates this fact clearly. A large number of osteoplastic metastases may raise the blood phosphatase level to values among the highest reported for any disease, for example, Gutman, Tyson, and Gutman have reported values as high as 120.4 Bodansky units per 100 cubic centimeter of blood serum.

It has been suggested that the elevation of the plasma phosphatase in destructive metastatic disease in bone is due to a mobilization of the enzyme normally present in the bone which is undergoing destruction. The amount of phosphatase present in normal adult bone, however, is practically nil (10); and the fact that the plasma phosphatase level is almost invariably normal in myeloma, in spite of multiple and very extensive areas of dissolution of bone, is strong evidence against this theory.

A word of caution must be given in the interpretation of phosphatase values in the presence of either incipient or established jaundice in cases with bone lesions, particularly in cases with carcinomatous metastases, because jaundice itself is frequently associated with elevated values of blood phosphatase of non-osteoblastic origin. The significance of the increased phosphatase activity of the blood in jaundice and toxic hepatitis has been thoroughly reviewed by several workers (3, 4, 7, 11, 26, 29) and is pertinent to the study at hand only insofar as the presence of latent or manifest jaundice and liver injury vitiates the value of the test in cases with concurrent bone lesions.

That concomitant affections of the liver markedly influence the phosphatase level of the blood should be taken into account in interpreting the values obtained in cases with bone lesions. This is well shown by the case

with a chondral exostosis recently reported by Lamb and Blakely in which our determination showed 0.83 Kay units of phosphatase per cubic centimeter of blood plasma. This patient also had syphilis and was receiving arsphenamine. Two days after the blood was taken for the phosphatase determination, the patient became jaundiced and it is believed that liver damage was the cause of the high reading. Woodard, Twombly, and Coley also found the phosphatase level of the blood invariably to be elevated after administration of Coley's toxins, and it is reasonable to suppose this elevation to be due similarly to a toxic effect upon the liver.

Minor degrees of obstruction produced by metastases in the liver, even when insufficient to produce clinical jaundice, may increase the phosphatase activity of the blood. Our experience agrees with that of Gutman, Tyson, and Gutman who state that, on the other hand, there may be at times a large number of metastases in the liver without any significant elevation of the blood phosphatase. The possibility of the presence of metastases causing obstruction in the biliary system should, nevertheless, be borne in mind when interpreting the phosphatase values in cases with carcinomatous metastases in the bone owing to the likelihood of concomitant metastases to the liver. Usually the latter does not need to be considered in primary bone tumors, however, since metastases from them to the liver are very rare.

OSTEOMAS, CHONDROMAS, AND OSTEOCHONDROMAS

The osteoblastic activity, and consequently the phosphatase production, in this group of benign bone tumors is usually so slight that it does not measurably elevate the blood phosphatase. As we have suggested, the rate of its excretion or destruction may possibly keep pace with its rate of production.

According to our observations, the blood phosphatase values in the benign bone tumors such as osteoma, chondroma, and osteochondroma, have been quite constantly normal. At most, in uncomplicated cases, they have just exceeded the normal values. The phosphatase determination has been of no value in determining the possibility of the occurrence of malignant changes in a chondroma, since in 4 cases with chondrosarcomas, the highest value found was 6.7 Bodansky units or 0.29 Kay units. At times, however, the increased osteoblastic activity in the malignant degeneration of a benign tumor which is producing new bone may be suggested by the increased phosphatase activity of the blood.

GIANT CELL TUMORS

Giant cell tumors of bone of non-parathyroid origin are essentially destructive in character with little tendency toward new bone formation. The paucity of osteoblastic activity is evidenced by the inconstant slight rise in the blood phosphatase values. In the 8 cases in which we have had the opportunity to examine the blood, the phosphatase has been at most only slightly elevated, usually to a high normal value. One patient, a child of 6 years, and another with an accompanying pathological fracture, had moderately elevated values, 0.41 Kay units and 7.4 Bodansky units, respectively. The phosphatase activity of the tissues in the giant cell lesions is only slightly greater than that of osteochondromas.

EWING'S TUMOR

Since Ewing's tumor is chiefly destructive, the phosphatase level of the blood may be expected to be only slightly disturbed. This has been true of the 8 patients we have examined, none having had more than twice the highest normal value for phosphatase activity in the blood. We have had no opportunity, however, to test the phosphatase activity in the type of Ewing's tumor seen especially in the shaft of the fibula and characterized by marked reactionary, new bone formation in which it would seem likely that the phosphatase level of the blood would be considerably elevated. Owing to the inconstancy of osteogenesis in Ewing's tumor, the level in the blood bears no constant relation to the extent of the disease, and the tissues of the lesions themselves which we have examined have shown only a trace of phosphatase activity.

OSTEOGENIC SARCOMA

The phosphatase level of the blood in cases with osteogenic sarcoma is almost invariably elevated to some degree. This level depends primarily upon the product of 2 factors; namely, the rate of growth, i.e., the osteoblastic activity of the lesions; and the size of the lesion, i.e., the number of malignant osteoblasts producing phosphatase. The level may vary from a very low one to levels among the highest reported for any disease. The highest value in our group was 4.79 Kay units per cubic centimeter of blood plasma, practically 20 times the highest normal value.

That the phosphatase elevation of the blood is the result of this lesion and not the cause of it, and that the osteogenic lesion is the source of the increased phosphatase activity of the blood, is strongly suggested by our observations showing that after removal of the lesion by amputation, the blood phosphatase returns to normal limits within a short period of time, usually in about 2 weeks. Our previous report (31) on this phenomenon was based on observations in 6 cases. We have since had the opportunity to study 5 additional cases in which a similar effect was observed.

The phosphatase level of the blood may become elevated again after the initial postoperative fall when latent metastases have become apparent. We have been unable, however, in the cases we have had an opportunity to follow, to prophesy the subsequent appearance of latent pulmonary metastases by the changes in the phosphatase values prior to the demonstration of the lesions roentgenographically. An example of this is the case of a 14 year old girl with an osteogenic sarcoma of the femur, whose serum phosphatase fell promptly to normal after amputation. However, one month after a normal phosphatase value had been obtained, she reported with clinical and roentgenographic evidence of pulmonary metastases. Thus, the phosphatase test appears not to be sufficiently sensitive to reveal small foci of osteogenesis. It has been found that pulmonary metastases must be of considerable size or number before they can be detected by the phosphatase determination, perhaps due to the fact that pulmonary metastases not infrequently show only minor degrees of osteogenesis. A roentgen examination of the chest is the best means for their detection.

That the osteogenic tumor is the source of the elevated blood phosphatase in this disease is further strengthened by the fact that very high degrees of phosphatase activity have been demonstrated in the tumor tissues themselves. Even metastases which are isolated from bone have been demonstrated to be high in phosphatase activity, as for example, metastases from osteoblastic tumors in the lungs or in the superficial soft parts. We have reported values as high as 95 Kay phosphatase units per gram of tissue in an osteogenic pulmonary metastasis in a young man of 23 years, and 209 units per gram in a primary osteogenic sarcoma in an adolescent boy (10).

DIFFERENTIAL DIAGNOSIS

In the differential study of cases with bone lesions, it must be conceded that the roentgenological examination of suspected cases of bone lesions makes the greatest independent contribution toward the establishment of the diagnosis; but even the X-ray picture is frequently equivocal, and confirmation or exclusion of the suggested diagnosis before operation often must rest upon the reports of the chemical laboratory. The importance of blood chemical determinations other than phosphatase, i.e., calcium, phosphorus, and serum protein, in the study of bone lesions obviously cannot be denied, and their values must also be considered together with the facts obtained from roentgenological and physical examinations, historical data, or additional laboratory data such as serological tests for syphilis, examinations of blood smears, and tests for Bence-Jones protein in the urine.

If the rôle of the phosphatase determination in the differential diagnosis of bone lesions is to be discussed with any degree of completeness, the rôle of other chemical constituents of the blood, especially calcium and phosphorus must be considered at the same time. Gutman, Tyson, and Gutman have made a comprehensive review of the chemical findings in reported cases of the bone lesions herein discussed, together with the histories of their own patients. We have also made cal-

cium and phosphorus studies in many of our own cases. From this combined experience we have constructed the accompanying table in summary of the results of calcium, phosphorus, and phosphatase determinations among the bone lesions herein considered. Hyperproteinemia and Bence-Jones proteinuria have also been included because of their importance in the differential diagnosis when present.

The difficulty in making a differential diagnosis by blood chemical means among hyperparathyroidism, multiple myeloma, and multiple carcinomatous skeletal metastases in which no primary source has been found (all of which may at times be confused roentgenographically) lies in the fact that hypercalcemia has at times been reported in all 3 conditions. Thus, hypercalcemia occurs almost as a rule in hyperparathyroidism, especially in cases with bone involvement; it occurs frequently in multiple myeloma and occasionally in cases with widespread skeletal metastases. In the latter 2 conditions it has been suggested that the hypercalcemia is related to the mobilization of the calcium in the dissolution of the bone or to co-incident renal insufficiency. The almost invariable association of hypophosphatemia with the hypercalcemia in hyperparathyroidism is of occasional assistance, but hypophosphatemia has also been found in cases of carcinoma with advanced skeletal metastases associated with cachexia, and also in multiple myeloma; but in the latter 2 conditions, a normal or elevated serum phosphorus is found more commonly even when hypercalcemia is present (2, 14). The blood phosphatase determination is occasionally of assistance among these patients, owing to the fact that even in the presence of extensive lesions of multiple myeloma, the blood phosphatase is almost invariably normal, whereas with multiple lesions from either metastatic carcinoma or hyperparathyroidism, the phosphatase level would be elevated at least somewhat, and occasionally elevated to quite a high level. In the differential diagnosis between metastatic carcinoma and hyperparathyroidism, the blood phosphatase perhaps would not be of much assistance, though it is probably higher in the latter condition when the lesions are of comparable extent.

The blood chemical findings may at times only add to the confusion. For example, Gutman, Tyson, and Gutman report that they have encountered findings similar to those which are usually thought characteristic of hyperparathyroidism in occasional cases of carcinoma with advanced skeletal metastases. They suggest that the hypercalcemia in these cases is related to the destruction of the bone by the neoplastic process, the hypophosphatemia probably to cachexia, and the increased blood phosphatase to involvement of the bone or liver. In such cases, the phosphatase determination would not be of much assistance in differential diagnosis; but fortunately at the stage of the disease when this confusion over the clinical findings would arise, the primary carcinomatous lesion is often evident.

The determination of the presence or absence of Bence-Jones proteinuria may be of value, since Bence-Jones proteinuria has been observed in cases of hyperparathyroidism only in rare instances, and then only in very small amounts (1); and its occurrence in cases with skeletal metastases from carcinoma is probably also quite rare. The finding of Bence-Jones proteinuria is of assistance in diagnosis only in 50 to 70 per cent of the cases with multiple myeloma in which it may intermittently appear. The occurrence of hyperproteinemia, also, may be of some assistance in suggesting the diagnosis of myeloma. It is only of irregular occurrence, however, and often does not appear until late in the disease. The serum protein level is probably always normal in carcinoma with metastases and in hyperparathyroidism.

Osteitis deformans may occasionally enter into differential diagnosis, especially with osteoplastic skeletal metastases from carcinoma, or, possibly, in an early exceptional case of Ewing's tumor in an older individual in whom the only changes present in the bone may be an increase in density. In early cases the blood phosphatase level may be slightly elevated in all 3 conditions. In more advanced cases with osteoplastic metastases from carcinoma, and in osteitis deformans also, the blood phosphatase is always elevated, perhaps relatively more in the latter. In

TABLE I.—ANALYTICAL FINDINGS IN VARIOUS BONE LESIONS

Bone lesion	Blood phosphatase	Hypercalcemia	Hypo-phosphatemia	Hyper-proteinemia	Bence-Jones proteinuria	Tissue phosphatase
Hyperparathyroidism (with bone lesions)	Moderately elevated	Almost always	Usually	Absent	Rarely	?
Osteitis deformans	Usually very high	Practically never	Practically never	Absent	Absent	Slight to high
Metastatic carcinoma	Normal to high	Rarely	Very rarely	Absent	Very rarely	None to slight
Osteogenic sarcoma	Moderately elevated to high	Absent	Absent	Absent	Absent	Slight to very high
Multiple myeloma	Almost invariably normal	Often	Very rarely	Often	Often	None
Ewing's tumor	Normal to slight	Absent	Absent	Absent	Absent	None to slight

Ewing's tumor, however, the elevation has never been found to be great even in late stages of the disease. In all 3 conditions the serum calcium and phosphorus values of the blood are normal, except in rare cases with associated renal insufficiency in which both the calcium and phosphorus may be somewhat elevated (14, 23).

It must be remembered, also, that osteitis deformans may exist concurrently with other tumors. In our own series a case occurred with a sarcoma in the head of the tibia of a woman 50 years of age, and the question of the simultaneous occurrence of Paget's disease of the bones of the pelvic girdle arose. In this instance the blood phosphatase value was high, and contrary to the usual experience after removal of a tumor of osteogenic character, it did not return to normal after amputation. Subsequently, the diagnosis of Paget's disease became unequivocal and the blood phosphatase activity continued at an elevated level. The tumor in this case was fibrous in character with only a small amount of reactionary, new bone formation in the periosteum. There was no phosphatase activity of the homogeneous tumor tissue taken at a distance from the periosteum.

In all cases with multiple bone lesions the possibility of malignant lymphoma should also be borne in mind. In the differential diagnosis of the latter the characteristics of the blood smear, the presence of hepatomegaly, splenomegaly, or enlargement of the lymph nodes are helpful in suggesting the diagnosis. Since the lesions of lymphoma are often osteoplastic as well as osteolytic, as Dresser and Spencer have shown, the phosphatase values may be expected to be quite variable in this disease, especially when hepatic changes may be concomitant and may themselves produce an elevated phosphatase activity of the blood. Four of five cases with lymphoma and bone involvement showed phosphatase activity above normal, but varying from a slight elevation (0.27 Kay units per cubic centimeter) to a rather high value (0.95 Kay units per cubic centimeter) in a case with extensive osteoplastic lesions.

Criticism has been directed against the diagnostic value of the phosphatase determination in bone lesions because of its lack of specificity, but chemical determinations absolutely specific for definite diseases are exceedingly rare; all must be interpreted in relation to other findings. Neither the occurrence of hypercalcemia nor even of Bence-Jones proteinuria is specific, yet none would deny their diagnostic value. The phosphatase activity of the blood is an important member of the group of chemical determinations on the blood, namely, calcium, phosphorus, serum protein, and phosphatase, all of which are of value in the differential diagnosis of bone lesions.

SUMMARY

Evidence is adduced to support the theory that the increased phosphatase activity of the blood in patients with bone lesions is the product of the intracellular activity of the osteoblasts. The level of the phosphatase activity found in the blood in the presence of a bone lesion corresponds closely to the theoretical expected level determined by a study of

the gross and microscopic evidence of the osteoblastic activity in the lesion.

Owing to the fact that the phosphatase activity of the blood varies in proportion to the osteoblastic propensities of the individual type of bone tumor, the phosphatase determination is often useful in the differential diagnosis of bone lesions.

The relationship of the phosphatase activity of the blood to calcium, phosphorus, and serum protein values found in various bone lesions is discussed.

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EXPERIMENTS CONCERNING LIGATION AND REFRIGERATION IN RELATION TO LOCAL INTOXICATION AND INFECTION

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SEVERAL previous papers (1) have described a plan of animal experiments in which limbs or viscera are deprived of circulation by means of a tourniquet and then kept at a temperature near 0 degrees C. for various periods, up to 16 hours for intestine and more than 2 days for limbs, with the result that they can afterward be restored intact without local necrosis or systemic shock. Suggestions were also made for possible clinical applications of this method. This paper describes experimental observations pertaining to intoxication and infection and discusses points which may merit clinical investigation.

EXPERIMENTS WITH STRYCHNINE

Strychnine sulphate was chosen as an example of a poison which is quickly absorbed and quickly oxidized. If a fatal dose of 1 milligram or slightly more be injected into the leg of a 2 kilogram rabbit, it may be possible to wait more than 1 minute until the first beginning of muscle spasms, and then check the symptoms by applying a tourniquet. For the sake of brevity, it may suffice to state only the course of events when a huge excess is injected, for example, 10 or 12 milligrams, or about 10 times the fatal dose. It is not possible then to wait 1 minute, for by the time of the first muscle spasm the absorption is so great that a tourniquet can no longer save life. In this case the tourniquet should be applied arbitrarily in 30 seconds or at least at the first detectable increase of reflexes. If the necessary course of tourniquet applications were to be performed at ordinary temperatures, considerable local inflammation and perhaps systemic shock would result. These consequences are avoided by immediately immersing the leg in ice water. In this condition the animal is safe for an indefinite number of hours, but the strychnine remains. Therefore, the ordinary procedure is the following: After an arbitrarily chosen period of 15 to 30 minutes the leg is removed from the ice water and the tourniquet is released. After 30 seconds the tourniquet is re-applied and the leg is again immersed. This process is repeated until cautious tests show that the diminished store of the poison permits the lengthening of the time of release to 1 minute and then several minutes. Watchfulness is necessary right to the end, for fatal strychnine convulsions have sometimes developed more than 15 minutes after the last tourniquet release. Depending upon the length of the periods of ligation and release, the rabbit may be finally freed in perhaps 16 to 24 hours without any important damage to the leg and without having shown any symptom of poisoning from 10 times the fatal dose.

Some rabbits which received enormous doses have died from simple weakness within a few days. It is undecided whether this result represents a delayed action of the strychnine, perhaps upon some organ other than the nervous system, or whether it is due to carrying through the experiment too rapidly or to any indefinite injury or strain of the procedure. It does not occur with smaller doses and is not significant for the present subject.

The only clinical example of poison entering through the limbs with any frequency seems to be snake bite. This differs from strychnine in that the poison is slowly absorbed, slowly destroyed, and is capable of serious local damage. The refrigeration method may with some modifications prove useful occasionally according to experiments with snake venom published elsewhere (2).

Another practical use of the refrigeration method is its use in infections in limbs. The cases must be divided into those in which

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there is to be an attempt to save the limb and those in which the limb is to be amputated.

REFRIGERATION WITHOUT AMPUTATION

Since blood and various tissues can be kept in a state of suspended animation in the ice box for several weeks or months without evident impairment of vitality, and since the normal legs of animals can likewise be kept ligated and refrigerated in ice water for at least a day or two and then restored to function, there is some temptation to learn what will happen if this procedure is applied to infected limbs. The speculation centers about the fact that the tourniquet instantly cuts off the flow of toxins from the limb, while the temperature presumably inhibits growth and other activity of the bacteria in the limb. In addition to the possible chance of devising any treatment for the limb at this temperature, there is the principal consideration of giving the patient at least a brief vacation from the intoxication, during which he may gain in strength and nutrition, receive any general or specific treatment, or develop antibodies which he may not have had time or ability to produce in the presence of an advancing infection. On the other hand the danger lies in the chance that removal of the tourniquet may not merely restore the status *quo ante*, but that the refrigeration period may entail damage to the limb or perhaps an overwhelming accumulation of bacterial or tissue toxins.

One series of experiments consisted in injections of a heavy suspension of rat feces into the legs of cats and dogs. Local abscesses and necrosis, and systemic malaise and intoxication, ranging from slight to fatal in degree, could thus be produced in a fairly controllable manner according to the dose. The refrigeration treatments may be divided roughly into short and long. In the former, the stoppage of circulation and immersion in ice water lasted from 2 to 5 hours. The effects were only slight, and as far as the course of the infection was changed at all it was slightly for the worse. In the long treatments the use of the tourniquet and refrigeration was continued for periods of 24 to 48 hours. Spectacular improvement was obtainable during such periods in dangerously intoxicated animals. The immediate benefit was greater than with amputation because of the absence of the shock of amputation. At the time of release of the tourniquet the limb appeared unchanged and the circulation returned promptly. Extensive masses of tissue, however, quickly turned dark and gangrenous; vessels became thrombosed, and the absorption of poison was so rapid that often the animals died in spite of early and high amputation. The rapidity of these changes created the impression that the chilling abolished certain vital barriers to the diffusion of bacterial products; that while the growth of bacteria might be inhibited, their existing toxins were able to spread with increased freedom and to form chemical combination with the protoplasm. The practical lesson at least was plain, namely, that prolonged ligation and refrigeration are positively contra-indicated in the presence of any necrotizing infection if it is planned to restore the circulation afterward.

In another series of experiments, with the aid of Dr. C. A. Vicens and Mr. J. G. Rice, the attempt was made to imitate another type of infection. This was done by injecting pure cultures of various streptococci into the legs of rabbits. The results were either a trivial local process or an overwhelming systemic invasion according to the dose. Also the addition of vegetable mucin to the injections failed to reproduce the desired clinical condition, namely, a local cellulitis and lymphangitis spreading up the leg and finally inducing septicemia. Treatments with the tourniquet and refrigeration were of no value whether long or short. Necessarily, the infection was held in check during the period of treatment, but the ultimate outcome was always more or less in favor of the untreated animals; and with certain doses of culture it was possible for the untreated animals to live while the treated ones died. This result might readily be accounted for by the general strain and chilling in such a feeble animal as the rabbit. There was no opportunity to make the real test, which would consist in holding an invasive infection in check for a day or two to give the animal time to develop antibodies under favorable conditions. The most definite fact elicited seemed to be that the streptococcus and its toxins did

not cause any gross tissue necrosis during the refrigeration or any gangrene after release of the tourniquet. In general, therefore, further trials of refrigeration in coccal infections did not seem to be entirely precluded.

Granting, as assumed above, that chemical combinations of bacterial products can occur during refrigeration, it was a natural suggestion to make use of the principle with antisera. In the refrigerated limb without circulation, not only may the increased permeability favor the penetration of the serum throughout the tissues, but it is also feasible to keep a high concentration of serum in direct contact with the tissues for long periods in a manner which is impossible with the blood flowing. Furthermore, it seems conceivable that the low temperature may alter the permeability of the membranes or protective envelopes of the bacteria themselves.

Accordingly, a few experiments were tried in which rabbits' legs were injected with streptococcus cultures, and subsequently with a polyvalent antistreptococcus serum.[1] The tourniquet and refrigeration were then applied as usual for several hours. These experiments had to be broken off in a preliminary stage before either positive or negative results could be definite. Such a research demands bacteriological facilities, also a true local infection and the appropriate antiserum. As some of these requirements could not be fulfilled, no conclusion could be reached.

A single clinical observation was made:

An obese woman, aged 56 years, evidently diabetic long before the diagnosis 11 years previously, had gangrene of the right foot 9 years before, and as the arterial changes were chiefly below the knee, amputation through the upper tibia was successful. In the subsequent years she violated diet repeatedly; several small gangrenous infections caused losses of portions of toes of the right foot but healed each time on control of the sugar. One week before admission an infection of a different type began with painful swelling in the ball of the foot, which extended rather rapidly in spite of treatment by her local doctor together with adequate insulin and diet control. She was admitted to the hospital in a supposedly critical condition, with extremely painful swelling up to midcalf; pink and white mottling was present but no dark color anywhere, and temperature ranged between 102 and 104 degrees. With local measures and strict diabetic treatment for 4 days the process extended almost to the knee. It was regarded as probably a streptococcic cellulitis. Roentgenograms showed no bone involvement; blood cultures were negative, but septicemia was feared and a surgeon was called to consider possible amputation. A short incision at the original point of swelling in the sole yielded only a thin serous discharge from which a culture was taken. It was decided to take the chance with refrigeration treatment as follows:

A tourniquet of rubber tubing was applied below the knee tightly enough to stop all circulation. The leg was immersed in ice water up to this tourniquet. The pain, which had been excruciating, began to subside within a few minutes and within half an hour was absent. Then 150 cubic centimeters of Lederle's polyvalent streptococcus-staphylococcus serum (purchased at a local drug-store) was diluted with an equal volume of Ringer solution, and the mixture was injected by multiple punctures so as to infiltrate the foot and leg as thoroughly as possible. After 3 hours the leg was removed from the ice water and the tourniquet released. Severe pain soon returned but no bad effects were evident. The rectal temperature steadily fell within 3 days to 100 degrees, and general and local recovery quickly followed. The culture from the foot yielded Staphylococcus aureus and a non-hemolytic streptococcus.

The patient left the hospital after 2 weeks, apparently in good condition except for considerable persisting pain. After another week, although the small exploratory incision was nearly healed and all obvious infection was absent, another small painful area developed more posteriorly and began to turn dark. Amputation was therefore performed below the knee, with a tourniquet and refrigeration for 4 hours as the only anesthetic. The subsequent course was uneventful except for the extrusion of 2 small sequestra.

There is no proof that the treatment with refrigeration and serum was of any value, for recovery might have occurred similarly without it. Evidently infiltration of the chilled tissues was a mistake, for such tissues become so firm and resistant that the infiltration probably causes breaks and tears, which may be suspected as the cause of the prolonged pain and perhaps also of injuries to small blood vessels. It therefore appears preferable to infiltrate with added novocain or other anesthetic after the placing of the tourniquet but before refrigeration. On the other hand, in view of the history and the state of the leg, there is no proof that the treatment was responsible for the failure to save the limb. At least the amputation was delayed and the field restricted so that healing was obtained below the knee instead of the thigh amputation which would have been necessary at the beginning. With 2

[1] Supplied for the purpose through the courtesy of Lederle & Co.

good knees the patient is looking forward to a rather active life. The single experience shows that no acute catastrophe need occur from brief refrigeration even of a badly nourished and infected limb. A second refrigeration for amputation was followed by healing which seemed very satisfactory under the conditions. Owing to the uncertainties, there is no present intention of using the refrigeration method again for limbs not to be amputated unless more definite experimental support is obtained.

It should be emphasized that the above reservations apply only to infected parts. For non-infected parts the existing experimental evidence is believed to establish positively the benefits of refrigeration, in creating tolerance for longer deprivation of circulation with less injury than at higher temperatures. Examples of probable clinical application are as follows: (1) for embolectomy and all other emergency operations after stoppage of the main artery of a limb; (2) for plastic or other operations which involve the use of a tourniquet for 1 to several hours, so that at least ice bags and iced sponges should be used during all such operations; (3) as a simple and harmless local anesthetic under various conditions. In general, the hopes are for an extension of the limits and improvement of the results of reparative and emergency surgery of limbs, inasmuch as immediate refrigeration can certainly keep a bloodless limb in much better condition during a more or less extended period before operation, can abolish pain and shock, and can perhaps mitigate the effects of trauma so as to favor subsequent healing.

REFRIGERATION PREPARATORY TO AMPUTATION

The technique consists in applying a rubber tube (not a broad tourniquet) well above the proposed level of amputation tightly enough to stop circulation after elevating the limb to drain out blood. The limb may then be immersed in ice water to slightly above the tourniquet, or for a weak patient it may be surrounded with ice inside a rubber sheet, for example by channeling a block of ice for the thigh to rest on and piling cracked ice above it. Though sedatives may be desirable for discomfort or nervousness at the outset, within about half an hour there is relief from even the most severe pain of gangrene. If the procedure is properly carried out, within 4 or 5 hours, depending on the thickness of the limb, there is such anesthesia present that the sciatic nerve can be cut without reaction. After ordinary preparation of the field, the operation can be done bloodlessly and apparently without the bad consequences which formerly contra-indicated the use of a tourniquet in diabetic and arteriosclerotic limbs. Sponging is done with iced saline, etc. Shortly before skin closure the tourniquet is released so any bleeding points may be ligated. The anesthesia persists about long enough for the skin suture.

Surgeons are often prejudiced against the novel idea of chilling the tissues and also the mess created by the use of ice. If usage warrants, it doubtless will be feasible to devise an apparatus for dry refrigeration which will fulfill the requirements of accurate chilling without freezing. Aside from incidental advantages, the proposed plan has a rationale similar to Crile's anoci-association. It is based upon the belief that in spite of anesthesia of the central or peripheral nervous system, tissues react to severe trauma in a manner which is detrimental to local healing and which also involves production of the toxic substances causing shock. Refrigeration certainly inhibits shock and perhaps favors healing. The method has been used for only 3 human amputations, and it can be said with due reservation that in this small experience no harm has been perceptible either to the tissues from the chilling or to the arteriosclerotic vessels from the tourniquet. The main basis of the suggestion is a large series of animal experiments. The results seem to warrant the hope that an amputation method which obviates pain, shock, and anesthesia may have some clinical usefulness. The incidental advantages of the method may be discussed with respect to (A) shorter and (B) longer refrigeration periods.

A. A patient with gangrene or infection is often received in a state of severe pain, intoxication, and weakness, and nevertheless must wait often 6 to 12 hours before operation, during which time he is quieted with somewhat detrimental doses of morphine. If a member of the house staff should merely apply a tour-

niquet and chill the limb, the patient would shortly be comfortable without drugs; there would be a better response to routine treatment and an appreciable subsidence of intoxication and fever; and everything could be in readiness upon the surgeon's arrival for operation without the usual anesthesia and other preliminaries. Such an amputation would be done a little below level of tourniquet as described.

B. An occasional patient is in such desperate condition that he will probably die from the operation and will certainly die without it. In such a case there is need for a method which will even temporarily offer the benefits of amputation without its dangers. Several surgeons have stated in personal communications that under these conditions they have sometimes applied a tourniquet at ordinary temperature in order to gain a respite of only a few hours. The advantage of refrigeration is that it extends these time limits, so that without any of the shock of amputation a patient can be kept comfortable for 2 days or if necessary longer, with the source of pain, toxemia, or bacteremia cut off as effectively as if there had been an amputation, thus furnishing opportunity for transfusion or other restorative treatments. Amputation should then be performed not below but at the level of the tourniquet, since the viability of tissues in a diseased or infected limb could not be trusted after such prolonged absence of circulation. If necessary, a higher tourniquet could be applied and the refrigeration carried correspondingly higher for a few hours to provide anesthesia for the operation.

SUMMARY AND CONCLUSIONS

1. When a poison such as strychnine is injected into a limb, a suitable series of treatments with tourniquet and refrigeration makes it possible to tolerate many times the fatal dose without harm.

2. A temperature slightly above 0 degrees C. in a limb reduces the metabolism of the tissues so as to enable them to withstand absence of circulation safely for hours or even days, a fact based on the same principle by which blood corpuscles and tissue fragments are preserved for weeks or months in the ice box without loss of vitality. It is believed that this principle has definite applications in practical limb surgery, as discussed, especially for emergency and reparative operations.

3. As the low temperature must also arrest bacterial activity almost completely, the speculative question arose whether the tourniquet and refrigeration could be used to stop the flow of toxins or bacteria from an infected limb, so as to allow an interval for rest and development of strength and antibodies. The question included also the possibility of special treatments during this interval, especially the effects of infiltrating the isolated limb with a specific antiserum which could thus be held for a long time in high concentration in the infected area. It was learned positively that long treatments cannot be used for any necrotizing infections, because of the gangrene which results from the prolonged contact of such toxins with the tissues even at low temperature. Also refrigeration for more than a few hours is believed to be contra-indicated in any limb which is to be saved. Short treatments of this kind do not cause gangrene in infections with organisms such as the ordinary cocci, and the method was actually tried in one human case. The investigation had to be abandoned for lack of facilities, and there is at present no proof that the plan is beneficial or that it may not be slightly harmful.

4. The refrigeration method can obviate pain, shock, toxic absorption, and the need for anesthetics. It can probably, therefore, have at least occasional usefulness in preparation for amputations. Owing to the very small clinical experience in comparison with the numerous animal experiments, the statements are largely theoretical and the exact clinical benefits or limitations still await decision.

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ANALYSIS OF IMMEDIATE POSTOPERATIVE COMPLICATIONS IN 2,000 CASES OF INGUINAL HERNIA

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THIS study was undertaken to obtain facts concerning postoperative complications in a group of apparently healthy individuals who underwent similar types of operations. All of these persons were operated upon for simple inguinal hernia, either oblique or direct in type. Consecutive cases have been chosen, except that any case in which an abnormality was noted at the time of the pre-operative physical examination or a complication of the hernia was recorded at the time of operation, was disqualified from inclusion in this series. All of these individuals had, to the best of our knowledge, normal cardiovascular, renal, and respiratory systems and none of the hernias were incarcerated or strangulated. The majority of these individuals had some type of test for syphilis and, if positive, this case was eliminated. The operations were performed by some fifteen different surgeons of the surgical staff of the Hospital for the Ruptured and Crippled, between the dates of January 1, 1933, and July 1, 1936. Approximately the same technique was used by all.

In the 2,000 cases there were 1,508 operations for single and 492 for bilateral hernias (2,492 actual operations). Of the single hernias 858 were on the right side (56 per cent) and 650 on the left. Only sixty-two (3.1 per cent) were in females. Fifty-seven per cent of the single hernias in the males and 60 per cent in the females were on the right side. Twenty-five per cent of the males were operated upon for bilateral hernia and only 12.3 per cent of the females. Only 88 (4.5 per cent) of the individuals were over 60 years of age; the ages of the remainder were distributed fairly evenly through the first 6 decades of life. The smallest number in this last group (8.3 per cent) were in the second decade. Seventy-five per cent of the individuals were between the ages of 20 and 59 years, inclusive.

There were 321 cases (16 per cent) in which postoperative complications were noted (Table I), with 5 deaths (0.25 per cent). All of the deaths were in cases of single hernia in men. Two were due to pneumonia and 3 to pulmonary emboli.

Almost twice as many complications occurred in patients operated upon for bilateral hernia (23.1 per cent) as for single (13.7 per cent). The rate of complications was slightly higher in those operated upon for right inguinal hernia (14.5 per cent) than for left (12.6 per cent). Complications followed operation more often in the case of the male than in that of the female patient; in 1938 cases of the former there were 313 (16.3 per cent) who developed complications and, in the 62 of the latter, 8 (12.9 per cent).

Considered according to age, there was a well marked increase in complications occurring from the third decade of life onward (Chart 1). During the first two decades of

TABLE I.—COMPLICATIONS

	Cases	Per cent
Wound hematomas	17	.8
Wound infection	99	4.9
Respiratory lesions	171	8.5
Thrombophlebitis	6	.3
Marked postoperative distention	6	.3
Persistent headache (following spinal anesthesia)	4	.2
Iodine dermatitis	2	.1
Cystitis	2	.1
Severe hiccoughing (local anesthesia)	1	.05
Gastric dilatation (spinal anesthesia)	1	.05
Postoperative psychosis (general anesthesia)	1	.05
Jaundice (spinal anesthesia)	1	.05
Bacillary dysentery	4	.2
Measles	1	.05
Scarlet fever	1	.05
Mumps	1	.05
Otitis media	1	.05
Unexplained diarrhea	1	.05
Toxic erythema	1	.05
	321	16.

From the General Surgical Service of the Hospital for the Ruptured and Crippled.

life the rate was low in cases of both single (11.1 per cent) and bilateral (9 per cent) hernias. During the third decade the rate remained approximately the same as in the previous decades in the cases of single hernia (9.7 per cent), but there was a sharp rise (17.1 per cent) in the rate for those of bilateral hernia. After the thirtieth year there was a fairly uniform rise in the rate of complications for each succeeding decade in the cases of single hernia, to a maximum of 24 per cent in persons over 60 years of age. A similar rise was noted in the cases of bilateral hernia; the steepness of the curve, however, was more marked and finally reached 35 per cent for individuals over 60 years of age.

There were 2,492 operative wounds in the 2,000 cases. In 17 instances postoperative hematoma was noted. This rate of 0.8 per cent for this complication per number of cases and 0.7 per cent per number of wounds appears to be unduly low. For an explanation, it is fair to assume that in many other instances hematomas occurred, became contaminated, and were subsequently recorded as infections. The frequency of hematomas in cases of single hernia was 1.1 per cent; in bilateral hernia 1 per cent by cases and 0.5 per cent by wounds. There was no instance of hematoma in both wounds in any case of bilateral hernia. The rate of hematomas by decades of life was first, 0; second, 0.6 per cent; third, 0.5 per cent; fourth, 1.3 per cent; fifth, 1.3 per cent; sixth, 0.8 per cent, and over 60, 1.1 per cent. With the use of catgut or silk as suture material, the frequency of this complication was 0.8 per cent and 0.9 per cent, respectively; kangaroo tendon or ox fascia, 1.3 per cent; and autogenous fascia, 0. Only 0.7 per cent of the cases in which general or spinal anesthesias were used were complicated by hematoma, while 1.2 per cent of those in which a local anesthesia was used were so complicated.

There was a total of 99 cases of wound infection; 4.9 per cent per number of cases and 4 per cent per number of operative wounds. We have divided the wound infections into three groups, according to their severity: (A) Superficial infections, stitch abscesses or infections occurring on a raw surface, the result

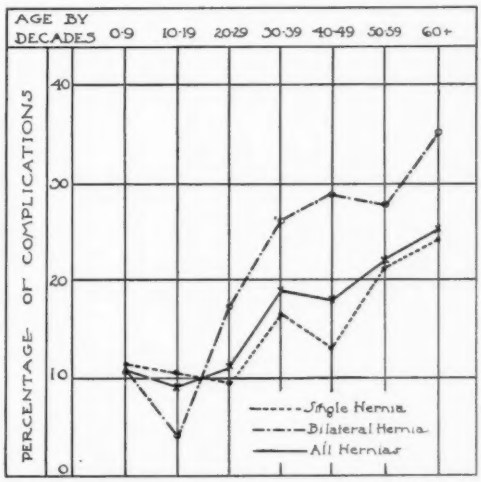

Chart 1. Age group—all types of complications.

of improper coaptation of the wound edges; (B) moderate infections, in which the subcutaneous tissue was involved but the hospital stay of the patient was not prolonged; (C) deep infections, in which the deeper tissues were involved, causing slough and prolonged hospitalization of the patient.

There were 53 cases of superficial infection (2.6 per cent). Thirty of these were in patients operated upon for single hernia, 2 per cent of the 1,508 cases, and 23 were in the group of 492 individuals with bilateral hernia, a rate of 4.7 per cent of infection. The moderate infections, 11 in number, for single hernia showed a rate of 0.7 per cent and for bilateral hernia, 4 in number, a rate of 0.8 per cent. The number of deep infections for the single hernia was 18, a rate of 1.2 per cent, and for the bilateral, 13, 2.6 per cent.

The rate by cases for moderate and deep infections was 2.3 per cent; in the group of cases of bilateral hernia it was 3.4 per cent. This was nearly double the rate for the cases of single hernia, which was 1.9 per cent. However, if figured by wounds, the rate for all wounds was 1.8 per cent. It was slightly less in cases of bilateral hernia than in those of single (29 infections in 1508 wounds of single hernias, 1.9 per cent, and 17 infections in 984 wounds of bilateral hernias, 1.7 per cent).

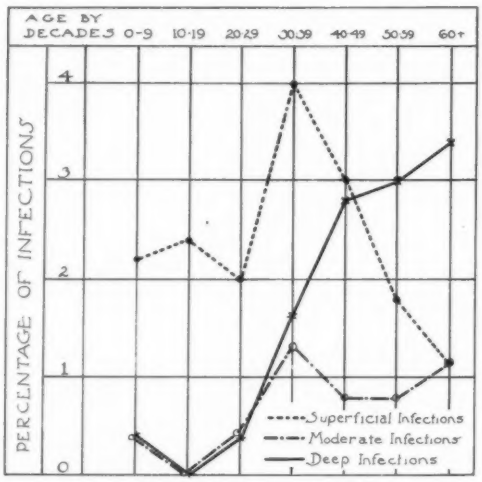

Chart 2. Age group—types of infections.

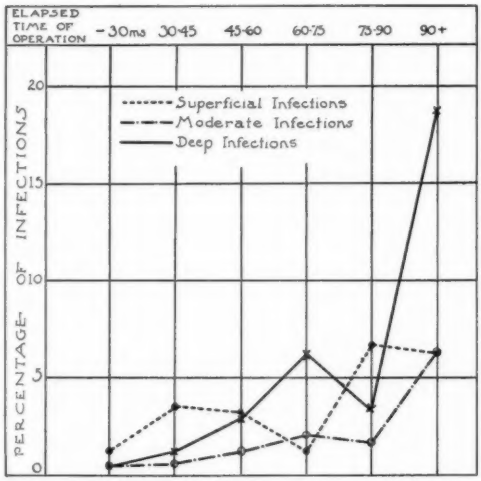

Chart 3. Infections in relation to time length of operation.

The superficial infections in cases of single and bilateral hernia showed much the same relationship, 2 per cent for the single and 2.3 per cent for the bilateral.

An analysis of cases by age groups (Chart 2) showed a rate of less than 0.2 per cent for the moderate and deep infections during the first three decades of life; the rate then increased. The deep infections continued to increase each succeeding decade, reaching a maximum of 3.4 per cent in persons over 60 years of age. The rate of moderate infections, after the thirtieth year, rose to around 1 per cent, where it remained during the later years. The rate of superficial infections appeared to be higher in younger persons, a little above 2 per cent, during the first three decades; it then rose to 4 per cent during the fourth decade and, finally, declined, being lower each succeeding decade, finally reaching 1 per cent in persons over 60. Studied by the number of wounds, the rates by age were slightly lower; the curve of the graph, though similar in form to Chart 2, shows, however, lower percentage values.

Wound infection was studied in reference to the elapsed time of operation. It was found that in the cases of both single and bilateral hernia there was an increase in the rate of infection in all types, superficial, moderate and deep, in direct relationship to the length of time of operation (Chart 3). This, as can be seen, is most marked in the case of deep infection, in which the rate rises to a maximum of 18.7 per cent after 1½ hours of elapsed operation time. By combining the moderate and deep infection rates and analyzing them in relation to elapsed time of operation, it is found that the rise of the infection rate in the case of single hernia occurred after a shorter period of elapsed operation time and rose more abruptly as this time lengthened, than in the case of the curve of the bilateral hernia (Chart 4).

Table II gives the data of wound infections in relation to the type of anesthesia that was used. The highest rate of wound infection per cases (3.6 per cent), as well as per wounds (2.7 per cent), occurred among the individuals on whom a spinal anesthesia was used. The rates of wound infection in the persons on whom general or local anesthesias were used were about equal, the latter being slightly lower (general anesthesia by cases 2.4 per cent and by wounds 1.7 per cent; local, by cases 1.8 per cent and by wounds 1.5 per cent).

Catgut was used in 1,529 cases, or in 1,905 wounds; silk in 326 cases, or 395 wounds; kangaroo tendon or ox fascia in 73 cases, or 90 wounds; and autogenous fascia in 72 cases, or

102 wounds. Chart 5 shows the percentage rate of all types of infections by cases, when these different kinds of material were used.

The lowest rate of infection occurred among individuals operated upon with the use of silk (2.7 per cent by cases, 2.3 per cent by wounds). Those with catgut were next in frequency (4.9 per cent by cases, 3.9 per cent by wounds). This was followed by those in which kangaroo tendon or ox fascia was used (6.8 per cent by cases, 5.6 per cent by wounds). By far the highest rate of infection was in those cases in which autogenous fascia was used as the suture material (13.8 per cent by cases, 9.8 per cent by wounds).

Not only were there marked differences in the rates of moderate and deep infections, in relation to the different kinds of suture material that were used, but also in the case of the superficial ones. This last type occurred in the following order of frequency according to the type of suture material that was used: kangaroo tendon or ox fascia, 1.3 per cent; silk, 1.5 per cent; catgut, 2.8 per cent; and autogenous fascia, 5.5 per cent.

Grouping the moderate and deep infections together, the order of frequency of infection in relation to suture material was silk (by cases 1.2 per cent, by wounds 1 per cent), catgut (by cases 2.1 per cent, by wounds 1.7 per cent, kangaroo tendon or ox fascia (by cases 5.5 per cent, by wounds 4.4 per cent) and autogenous fascia (by cases 8.3 per cent, by wounds 6 per cent). With the use of each type of material the rate of infection in the cases of bilateral hernia was twice that of single, except in the cases in which silk was used as suture material.

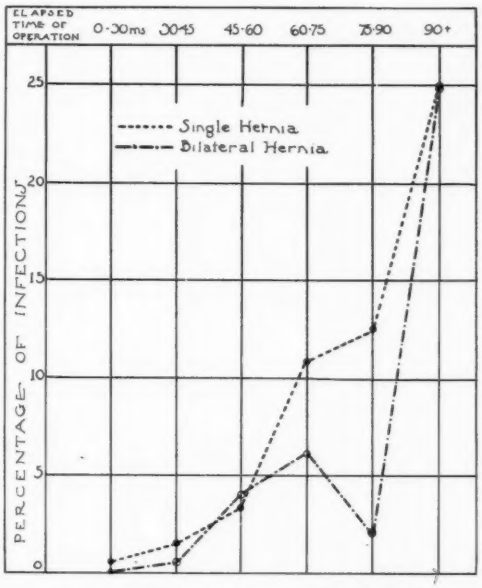

Chart 4. Moderate and deep infections in single and double hernias in relation to time length of operation.

There were 171 (8.6 per cent) cases of respiratory complications following operation; only 71 (3.5 per cent) were of a serious nature; 46 cases of atelectasis (2.3 per cent); 13 cases of pneumonia (0.7 per cent); and 12 cases of pulmonary embolus (0.6 per cent). There were 21 cases of upper respiratory infections (1.1 per cent), 77 (3.8 per cent) of severe cough without any demonstrable lesion, and 2 (0.1 per cent) of bronchitis. Those operated upon for bilateral hernia showed a much higher frequency of respiratory complications

TABLE II.—WOUND INFECTIONS IN RELATION TO ANESTHESIA

Types of anesthesia	Single hernias			Bilateral hernias			Total hernias			Wounds of bilateral hernias			Total wounds		
	Cases	Infections		Cases	Infections		Cases	Infections		No. of wounds	Infections		No. of wounds	Infections	
		No.	%		No.	%		No.	%		No.	%		No.	%
General	777	14	1.8	236	7	3	1013	21	2.4	472	7	1.5	1249	21	1.7
Spinal	279	9	3.2	138	6	4.3	417	15	3.6	276	6	2.2	555	15	2.7
Local	452	6	1.3	118	4	3.4	570	10	1.8	236	4	1.7	688	10	1.5
Total anesthesias	1508	29	1.9	492	17	3.4	2000	46	2.3	984	17	1.7	2492	46	1.8

Number of moderate and deep infections in relation to different types of anesthesia.

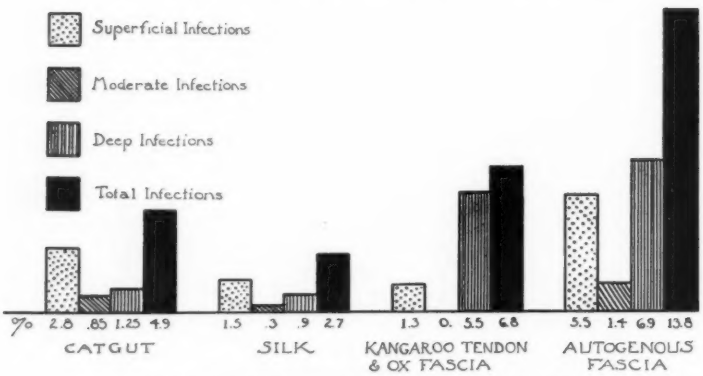

Chart 5. Wound infections in relation to suture material.

than those for single hernia, 12.6 per cent and 6.7 per cent, respectively. This difference, however, is not apparent in persons under 20 years of age, in whom the more common complications were more often the mild types of infections which were equally distributed in the younger and older groups. The frequency of atelectasis following operation in the cases of single hernia was 2 per cent and for bilateral hernia 3.2 per cent; pneumonia followed operation for single hernia at a frequency of 0.5 per cent and in that of bilateral at 1.2 per cent. Pulmonary embolus, however, followed operation for single hernia more often than for bilateral hernia (0.7 per cent for former, 0.2 per cent for latter)

Taking the number of respiratory complications as a whole, their frequency did not appear to be affected by the age of the patient. Individually, however, the age of the patient apparently played some part in the rate of occurrence. Upper respiratory infections occurred in 7 (3.1 per cent) of the 228 children, but in only 14 (0.8 per cent) of the 1,772 older individuals. The frequency of postoperative cough increased in proportion to the age of the individuals, by decades.

Cases of atelectasis appeared during all the decades of life (Chart 6); the rate was lowest during the first 2 (0.4 per cent and 1.2 per cent, respectively) and remained the same (2.7 per cent) in the succeeding ones.

Pneumonia was more common in the aged (Chart 6), occurring in 6 instances (1.9 per cent) in 325 cases of individuals older than 49 years and in but 7 instances (0.4 per cent) in 1,675 cases of persons who were younger than 50 years. Two individuals died from postoperative pneumonia (15.4 per cent); each was over 50 years of age.

There was not a single case of pulmonary embolus in the 394 patients under 20 years of age (Chart 6); an incidence of 0.3 per cent occurred during the third and fourth decades, which increased to 1.3 per cent during the fifth, then fell to 0.8 per cent in the sixth and finally reached a high of 3.4 per cent in persons over 59 years of age. There were 3 deaths in this group (25 per cent); 1 of these individuals was in his fifth decade of life and the other 2 were over 60 years of age.

The study of respiratory complications, in relation to elapsed time of operation (Chart 7), showed a definite increase in the morbidity for each succeeding period of time up to 75 minutes and from there onward a decrease in the frequency. However, in the latter group there were only 75 cases—perhaps too few to obtain a true value. There were 1,440 operations which were performed on an average of under 45 minutes; in these there were 110 cases with complications, 7.6 per cent. Three hundred and forty operations were done in an average time of between 45 and 60 minutes; 33 of these individuals had complications, a rate of 9.7 per cent. One hundred and five operations were finished in an average period of time of 60 to 75 minutes; in this group

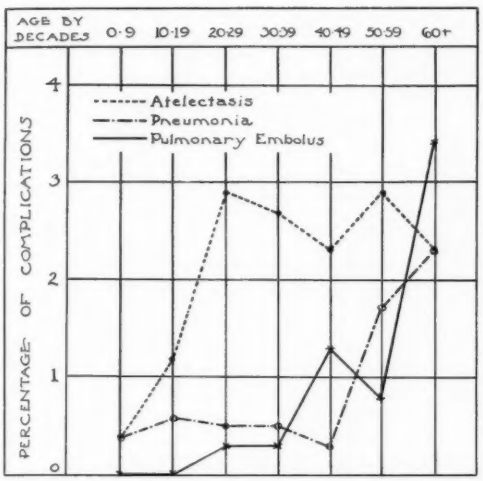

Chart 6. Respiratory complications in relation to age.

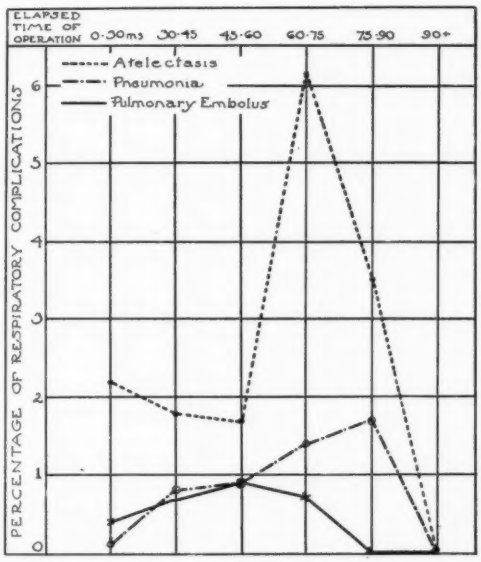

Chart 7. Respiratory complications in relation to time length of operation.

there were 23 complicated cases, 15.9 per cent. Seventy-five operations took over 75 minutes; complications followed in 5 cases, 6.7 per cent. The frequency of the mild types of respiratory infection conformed to this rule, as well as the more severe. Only in the case of pulmonary embolus was there any variation.

The frequency of atelectasis as a postoperative complication in 1,780 cases in which operations were performed in less than 60 minutes was 2 per cent; in 220 cases in which the operation took over 60 minutes, the frequency was 5 per cent (Chart 7). The rate of frequency of pneumonia in the first group was 0.6 per cent and in the second 1.4 per cent.

The incidence of pulmonary embolus, when analyzed in its relationship to the elapsed time of operation, did not conform to those of the other types of respiratory complication. The rate of frequency rose from 0.4 per cent for individuals whose operations took less than 30 minutes, to a maximum of 0.9 per cent when the operations were performed in from 45 to 60 minutes, and then fell to zero when the time was longer than 75 minutes (Chart 7).

General anesthesia (ether, nitrous oxide, ethylene or a combination of one of the gases with ether) was used in 1,013 cases; spinal anesthesia (novocain) was used in 417; and local (novocain) in 570 cases. There were 74 (7.3 per cent) cases of respiratory complication following general anesthesia; 38 (9.1 per cent) following spinal anesthesia; and 59 (10.3 per cent) following local.

Cases of upper respiratory infection and of unexplained cough occurred with almost equal frequency regardless of what type of anesthesia was used.

Atelectasis followed in 3.4 per cent of the cases in which spinal anesthesia was used, 3.3 per cent in which local was used, and only 1.3 per cent in which general anesthesia was used. Pneumonia, on the other hand, appeared most frequently after general anesthesia, 1 per cent; and 0.2 per cent and 0.4 per cent, respectively, for spinal and local anesthesias.

The frequency of pulmonary embolus as a postoperative complication appeared more frequently when a local anesthesia was used (0.9 per cent); the frequency for spinal (0.2 per cent) and general (0.5 per cent) anesthesia was less in both cases when an analysis is made of the entire series. However, if the 394 cases of individuals under the age of 20 years are eliminated, as no case of pulmonary

embolus appeared among them and as the majority (91 per cent) received general anesthesia, the frequency of this complication, in relation to the type of anesthesia that was used, becomes changed. Under this change it is found that in the cases in which local or general anesthesia were used, in each instance pulmonary embolus appeared at a frequency of 0.9 per cent, while with spinal anesthesia it was only 0.2 per cent.

Comparing the frequency of atelectasis, pneumonia, and pulmonary embolus as postoperative complications, to the type of suture material employed, the 1,606 cases of persons over 19 years of age have been used for this analysis as it is believed a fairer conclusion can be reached, as in the younger group of individuals kangaroo tendon, ox fascia, and autogenous fascia were seldom used and because these complications were infrequent under the age of 20 years. These pulmonary complications were found to be higher in frequency when kangaroo tendon or ox fascia (7.6 per cent) and autogenous fascia (7.1 per cent) were employed, than when catgut (3.7 per cent) or silk (4.4 per cent) were used as suture material. The frequency of atelectasis was 2.4, 3, 3, and 5.9 per cent in the use of catgut, silk, kangaroo tendon or ox fascia and autogenous fascia, in the order given. The frequency of pneumonia was 0.4, 1, 3, and 1.4 per cent, in the above order, and pulmonary embolus was 0.9, 0.3, 1.5, and 0 per cent.

Thrombophlebitis was a complication in 6 cases; 3 of single hernia (0.2 per cent) and 3 of bilateral (0.6 per cent). The frequency did not appear to be affected by the type of anesthesia or the kind of suture material.

CONCLUSIONS

Any conclusion that may be drawn from a statistical report is open to correction and should not be considered as final. The opportunities for the occurrence of erroneous conclusions are many. The greatest of these is the inability to study a large enough series of cases, so that the smaller groups may contain a sufficient number to obtain true values. Further, erroneous conclusions are bound to occur when there are multiple factors to be considered in obtaining results, as it is often impossible to separate the true elements that contribute to a given conclusion from the others that may be present. This study of a series of 2,000 cases of simple inguinal hernia, in which the immediate postoperative results are analyzed, is open to both of these objections. However, it is believed that the conclusions that are drawn are of sufficient value to publish, in the hope that later others may add their experiences to ours.

Bilateral hernia. The risk of complications in operations for bilateral inguinal hernia was nearly twice that of single hernia. During the first two decades of life this danger was not evident, but in each subsequent one the postoperative morbidity in the case of bilateral hernia was far greater than in the case of single (Chart 1).

Wound infection occurred more than twice as often in cases of bilateral hernia. This ratio was manifested in the group of mild or superficial infections, as well as in those of the moderate and deep types. However, if studied by wounds, infection was as frequent in those of single hernia as of bilateral.

The risk of respiratory complications in the cases of bilateral was much greater than in the cases of single hernia. Both atelectasis and pneumonia followed operation twice as often in the former group as they did in the latter. Pulmonary embolus, however, followed operation twice as often in cases of single hernia. Thrombophlebitis was more commonly observed among the cases in the bilateral group.

Age. The age of the patient was an important factor in relation to the rate of morbidity (Chart 1). Up to 30 years of age, complications were relatively infrequent; from then on there was a steady rise in their frequency in each succeeding decade.

The frequency of cases of mild or superficial wound infection apparently was not affected by age, but the frequency of cases of moderate and deep infection, which remained uniformly low during the first three decades of life, rose rapidly in proportion to the age of the patient during the later decades (Chart 2).

The frequency of respiratory complications, taken as a whole, were distributed more or

less uniformly through all the decades of life. Mild types of upper respiratory infection were frequently encountered in the children and young adults. The more serious complications, however, were found more often in the older individuals, their frequency increasing as age advanced (Chart 6). Atelectasis was relatively uncommon in those under 20 years of age; after this it was equally frequent in each succeeding decade. Pneumonia appeared equally as often in each of the first five decades of life and then its frequency increased rapidly during the succeeding years. No cases of pulmonary embolus occurred during first twenty years of life, but from then on there was a decided increase by decades.

Elapsed time of operation. The period of time used in performing the operation played an important part in the rate of frequency of both wound infection and severe respiratory complications. The frequency of all types of wound infection increased as the elapsed time of operation was lengthened. This was, however, most evident in the cases of moderate and deep infection (Chart 3). The curve for these types of infection rose rapidly from less than 0.5 per cent, for a 30 minute period, to 25 per cent, when the operation took longer than 1½ hours to perform. The curve is much the same for cases of both single and bilateral hernia, though, as would be expected, the rise of the curve for the latter type of case lags slightly behind the former (Chart 4).

Respiratory complications occurred more frequently as the period of time for operation was lengthened. This was evident in the mild types of upper respiratory infection, as well as the more serious pulmonary complications. Under a period of one hour, the frequency of atelectasis remained about 2 per cent and then rapidly rose. The frequency of pneumonia increased in proportion to the length of elapsed time of operation (Chart 7). (Both of these curves fell to zero when the time was longer than 90 minutes. However, this may have been due to the small number of cases in this group; only 16.) The curve for the frequency of cases of pulmonary embolus rose from a low in the shortest period of time, reached its high when the elapsed time of operation was between 45 minutes and 1 hour, and returned to zero when the time was under an hour and a quarter.

Anesthesia. The morbidity from wound infection was slightly lower in those cases in which a local anesthesia was used (Table II); that for general anesthesia was a quarter again as high; and that for spinal twice that for local anesthesia. Considering the rate of frequency in relation to the wounds, that of general and local anesthesia was about equal and a third less than that of spinal.

The type of anesthesia which was used did not affect morbidity from mild upper respiratory infections. However, it did appear to affect that from the more serious pulmonary complications. Atelectasis appeared almost twice as frequently when local or spinal anesthesia was used, as it did when a general anesthesia was used.

Pneumonia, on the other hand, occurred more than twice as often following the use of general anesthesia. Pulmonary embolus appeared as a complication one-third as often following spinal anesthesia, as it did following either general or local anesthesias.

Suture material. The frequency of wound infection following the use of silk was nearly one-half that of catgut, one-third that of kangaroo tendon or ox fascia, and one-fifth that of autogenous fascia (Chart 5).

The more serious pulmonary complications occurred about twice as often among those cases in which kangaroo tendon or ox fascia or autogenous fascia were used, as among those in which silk or catgut were used.

SUMMARY

The immediate postoperative complications in a series of 2,000 cases of simple oblique and direct inguinal hernias have been analyzed. This analysis has been made in relation to whether the individual had a single or bilateral hernia and as to sex, age of the patient, and elapsed time of operation, the type of anesthesia used, and the kind of suture material that was employed at operation. Seven graphs illustrate these complications.

CLINICAL SURGERY

FROM ST. PETER'S HOSPITAL FOR URINARY DISEASES

THE RECONSTRUCTION OPERATION FOR ADENOMATOUS DISEASE OF THE PROSTATE

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THE surgeon who designs an operation intended to restore an organ to its normal anatomical and physiological states, following the removal of diseased tissues which have caused dysfunction, must be guided by the following principles: (1) hemorrhage must be under complete control; (2) sepsis must be avoided; and (3) tissues which have been divided must be brought together again in correct alinement. These are well known principles which the medical profession has put into practice since the introduction of antiseptic and aseptic surgery, but, until recent date, they have been considered impossible of achievement in operations on the prostate gland. The anatomical position of the organ and the frequent presence of chronic sepsis have led surgeons to believe that they cannot carry out in this region of the body the technique which embodies the principles taught them from their student days.

Today, the introduction of flood lighting in a body cavity and the invention of instruments designed to overcome successfully an operator's difficulties with manipulation of deep seated tissues have placed the technique of prostatectomy on an equality with that of the surgery of any other organ. The pioneer surgeons of successful prostatectomy showed fine courage and tenacity of purpose against severe criticism, but it was a crude operation. The procedure was a blind one. The open operation which replaced it in 1916 was an attempt under direct vision to control hemorrhage and sepsis. Reconstruction was looked upon as an idle dream.

The purpose of this article is to describe a technique which under certain conditions makes reconstruction following total removal of adenomas of the prostate a successful operation.

For this technique the pre-operative preparation is similar to that for any other operation upon the prostate gland. The tests for determining renal function to all intents and purposes are now standardized and exact, but we have yet to find some method which will measure with accuracy the resistance to infection of the kidneys following upon these operations. At one time it was hoped that the estimation of the blood cholesterol would help to solve this problem, but experience has shown that no reliance can be placed on it.

Anesthesia. Ether anesthesia is employed in all cases with induction by gas and oxygen. In very nervous patients a small dose of sodium evipan, sufficient to produce unconsciousness for 10 minutes, is given intravenously before the patient is transferred from his bed to the anesthetic room. Spinal anesthesia is not recommended. Relaxation by inhalation ether is just as satisfactory as by a drug injected into the spinal theca, for the lowering of blood pressure associated with spinal anesthesia is a distinct disadvantage. Lung complications also are not ruled out by this method of anesthesia administration.

As soon as the patient has been placed upon the operating table, a catheter is passed, and the bladder is washed out with 1:8000 oxycyanide of mercury. The organ is then distended with about 10 ounces of this solution. The surgeon now proceeds to dissect out the vas deferens immediately below the external abdominal ring and divide it (Fig. 1). Through the proximal end of the cut vas a blunt hypodermic needle is passed into its lumen and with a syringe 10 cubic centimeters of a solution of 1:80 carbolic acid are injected into the seminal vesicle (Fig. 2). The object of division of the vas is to prevent epididymo-orchitis and by irrigating the seminal vesicles before the bladder is opened we ensure sterilization of these organs. In patients who have submitted to preoperative bladder drainage by a tied in catheter, vesiculitis is extremely common. Irrigation, therefore, of these organs removes bacteria which have gained access through the irritation caused by the indwelling catheter. There is no need to ligature the divided ends of the vas deferens for the lumen

Fig. 1. Drawing to show the vas deferens exposed and divided in the upper part of the scrotum. A hypodermic needle has been inserted into the proximal end for irrigation of the seminal vesicle with 1: 80 carbolic acid.

Fig. 2. Roentgenogram of the left vas deferens, the left seminal vesicle and the prostatic urethra outlined by sodium iodide which has been injected into the lumen of the vas just below the external abdominal ring. The shadow above the seminal vesicle represents an excess of sodium iodide which has flowed back from the prostatic urethra into the bladder.

is rapidly sealed by scar tissue. The patient is now placed in the Trendelenburg position and the surgeon proceeds to expose the bladder by a subumbilical incision. The fluid contents are evacuated by a special trocar and cannula which acts by suction. The appearance of the internal meatus, in cases of adenomatous disease of the prostate is always instructive; therefore visualization of the internal meatus, though not an essential part of the technique, is an aid to understanding of the causes at work which produce retention. It is also helpful in determining why the patient develops residual urine in these cases. With patients in whom a large amount of residual urine is present the internal meatus may have been pushed forward so far by the developing adenomatous mass that it lies within an inch of the anterior wall of the bladder.

The pathological mass of adenomatous tissue is then enucleated from within the prostatic bed by the intra-urethral method. The finger is inserted into the internal meatus and the mucous membrane is ruptured. The finger is swept round the tumor which is easily separated from the surrounding glandular tissue. The urethra is then fractured as near to the verumontanum as is possible. The amount of urethra left behind proximal to the triangular ligament is dependent upon the extent of the growth. If the whole of the prostatic portion is surrounded by adenomas, the fracture occurs at the point where the urethra passes through the triangular ligament. On the other hand, if the main mass is intravesical, a considerable length of prostatic urethra can be left behind.

The surgeon, after the pathological mass has been removed, then inserts into the bladder the special illuminated retractors (Fig. 3), to each fenestrated blade of which is attached a small electric lamp. The blade which retracts the posterosuperior wall of the bladder is so shaped that it not only retracts this part of the bladder but also the base. With the aid of these three lamps the interior of the bladder is so well flood lighted that a perfect view is obtained of every detail, excluding, of course, the prostatic cavity.

After removal of any clots which have collected in the operation area, the illuminated anterior retractor (Figs. 4 and 5) together with the prostatic speculum is inserted into the prostatic cavity (Figs. 6 and 7). The blades of the speculum not only act as retractors by opening up the entrance to the prostatic cavity, but also by their pressure upon the lateral walls function as temporary hemostats. The prostatic cavity is flood lighted by two tiny lamps attached to the anterior retractor; within the handle of this instrument is a three voltage dry cell battery. The prostatic cavity is so well visualized by this instrument that it is possible not only to see the floor of the cavity but also the prostatic surface of the triangular ligament with the protruding torn portion of the prostatic urethra (Fig. 9). The trigonal flap of the mucous membrane is now stitched if possible to the mucous membrane of the urethra. If this is not possible because of the extent of prostatic urethra removed by enucleation, the flap is stitched as near the triangular ligament as is possible. The stitching is done with the aid of the boomerang

Fig. 3. The special illuminated bladder retractor.

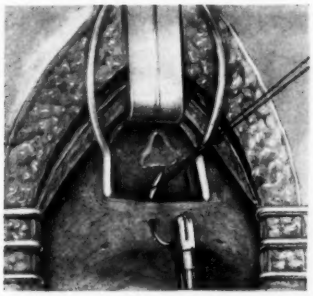
needle. Because of the tendency of the trigonal flap to retract when a Lembert suture is used, a special stitch, as shown in the illustration, is adopted. Care must be taken that the boomerang needle (Fig. 8) is inserted only through the trigonal flap and the superficial tissues forming the prostatic bed (Fig. 10). There is no need to insert the needle deeply into these tissues for all that is required is to bind down the mucous membrane of the trigone to the floor of the prostatic cavity. The criticism which has been made that the point of the needle may be inserted too deeply, can be justified only if the operator is ignorant of the principles involved in this operation. As soon as this stitch has been tied (Fig. 11), a soft rubber catheter of the Malacot type, No. 22 French in size and with two eyes, is inserted by means of an introducer through the urethra and prostatic cavity into the bladder. This catheter should be about 15 inches in length. The catheter is now drawn out through the bladder wound, the mushroom end is cut off and a silkworm gut suture is passed through it immediately distal to the second eye. This is the suture which will retain the catheter in its correct position.

The operator now proceeds to reconstruct the internal meatus by means of a figure-of-eight stitch (Fig. 11). This is inserted into the mucous membrane and submucous tissues which form the lateral walls of the prostatic cavity; on no account should this suture be inserted into the tissues external to the flaps. Figure 11 shows clearly how this suture is inserted. It has a twofold purpose: (1) reconstruction as already stated, and (2) to act as a hemostat. The reconstruction part of the operation is now complete. The catheter is placed in position so that both eyes are within the bladder. Before the retractors are removed all clots must be swabbed out from the bladder and the new internal meatus visualized. The latter has two striking features: first, it is on a level with the base of the bladder thus entirely obliterating the post-prostatic pouch, and, second, it closely resembles the appearance of the internal meatus in a normal bladder. The surgeon now proceeds to pass the silkworm gut suture (Fig. 13) holding the catheter in position through the bladder and abdominal walls and out through the skin. Care must be taken not to puncture the deep epigastric vessels with the needle by keeping close to the cut edges of the skin.

The next step is to close the anterior wall of the bladder, but primary closure must be practiced only if the urine before the operation is sterile, and the surgeon is sure that he has controlled the bleeding of the lateral walls of the prostatic cavity (Fig. 13). Therefore the contra-indications for primary closure are infective pyelonephritis, severe cystitis, and inadequate hemostasis. In these

Fig. 4. Anterior bladder retractor with prostatic speculum unattached.

Fig. 5. Prostatic speculum attached to anterior bladder retractor.



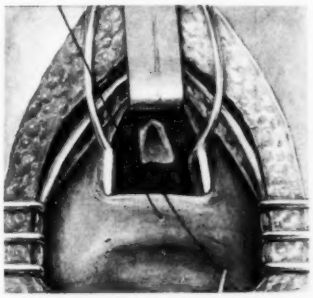


Fig. 6, left. The anterior illuminated retractor with the prostatic speculum is seen in position. The prostatic bed and the torn end of the prostatic urethra are visualized. The boomerang needle has been passed through the mucous membrane of the trigonal flap and the catgut suture has been attached to it.

Fig. 7. A drawing to show the first maneuver of the trigonal flap suture.

cases a small angular White's tube suffices to assist in bladder drainage. It is essential, when primary closure is practiced, to drain the prevesical space by means of a corrugated rubber wick. Slight leakage of urine always occurs into this space, but will cause no trouble if there is a vent for its escape. Lastly, the ends of the silkworm gut suture which maintains the catheter in its correct position are immobilized by metal buttons of the Emesay pattern (Fig. 14).

Before the patient's return to bed the bladder should be irrigated through the catheter. If hemorrhage has been efficiently controlled, the return of fluid will be scarcely blood stained.

Immediately the patient is returned to the ward, the head of his bed is raised about two feet from the ground. Not only does this position assist drainage from the bladder, but it adds enormously to the comfort of the patient. The catheter (Fig. 15) is attached to a special glass urinal which lies between the patient's thighs. It is instructive to note how little discomfort is caused by the presence of a soft rubber catheter in the urethra, maintained in position by the technique which has just been described. The catheter in the urethra strapped to the penis is a form of torture which is entirely dispensed with by this method of fixation. It is an important step forward in adding to the patient's comfort during postoperative convalescence. The degree of urethritis is negligible and the catheter, so long as the silkworm gut suture is intact, never alters its position, however much it may be dragged on.

A convalescence free from complications is largely dependent upon efficient after-treatment. By elevating the head of the bed better bladder drainage, via the catheter, is assured. For the first 24 hours, the bladder must be irrigated through the catheter, at intervals of 2 hours, with not more than 2 ounces of a solution of 1:8000 oxycyanide of mercury at a temperature of 90 degrees F. For the first few days after operation, the bladder is intolerant of distention by more than 2 or 3 ounces. It is for this reason that care must be taken not to inject more than this amount each time. If primary closure has been practiced, it is advisable to irrigate every hour for the first day. Sometimes a small clot will block the catheter; this can be easily removed by using the syringe as a suction apparatus.

The day following operation the irrigation should be reduced to four hourly. The necessity for using a solution at a temperature of not more than 90 degrees F. is apparent, if one realizes how sensitive the bladder mucous membrane is to heat; also fluid of a temperature above body heat is likely to increase the oozing of blood. The urine remains

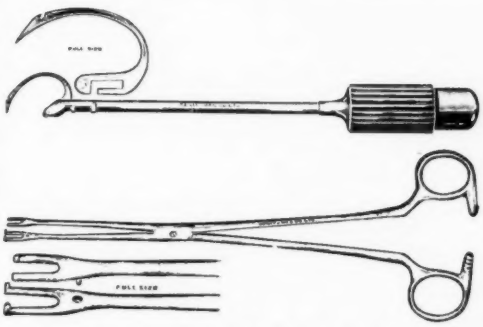


Fig. 8. The boomerang needle. Special instrument used for threading boomerang needle.

Fig. 9.

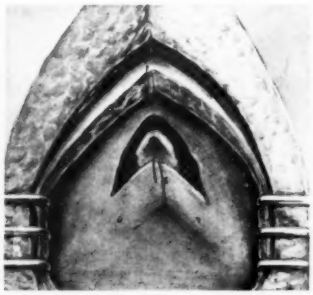


Fig. 10.

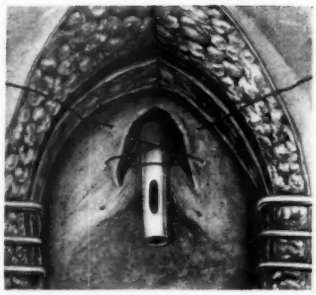


Fig. 11.

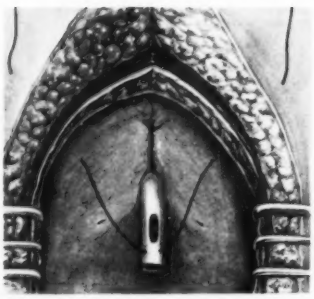


Fig. 12.

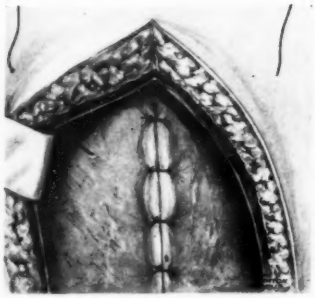


Fig. 13.

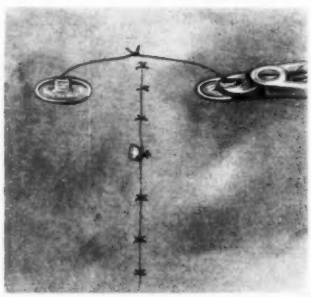


Fig. 14.

Fig. 9. A drawing to show the second maneuver of the trigonal flap suture. The needle has been passed through the whole thickness of the trigonal flap, the prostatic tissue forming the bed and the torn mucous membrane of the urethra. The needle is threaded with the flap suture.

Fig. 10. The trigonal flap suture has been tied. Note that retraction of the flap is impossible.

Fig. 11. The urethral tube in position after the posterior stitch has been tied. The figure-of-eight suture has been inserted. The knots in the trigonal flap are incorrectly drawn and can be ignored.

Fig. 12. The figure-of-eight stitch has been tied. A suture has been passed through the catheter, lateral walls of the bladder, and abdominal wall. (The anchoring stitch for the urethral catheter.)

Fig. 13. The anterior wall of the bladder completely sewed up. The anchoring stitch can be seen protruding through the skin of the abdominal wall.

Fig. 14. Drawing to show the edges of the skin sutured together and the protruding corrugated rubber wick. On either side of the wound can be seen metal buttons which grip silkworm gut sutures holding catheter in position.

blood stained for about 3 days. If an angular White's tube has been inserted at the time of operation, it can be removed on the fourth or fifth day. The catheter remains *in situ* for 12 days. It is easily withdrawn by dividing the silkworm gut suture beneath one of the buttons. This suture is then pulled out with the aid of the other button.

If the prevesical space has been drained by means of a corrugated rubber wick, its retention is not needed for longer than 3 or 4 days.

Directly the catheter is removed, the patient passes urine by the urethra. For some days micturition is about two hourly, but by the time the patient leaves the hospital, on an average about the twenty-fourth day, micturition has become four hourly.

The abdominal wound should be securely healed within 3 weeks of the operation; in many cases the healing is complete by the fourteenth day. The extent of urine leakage when a White's angular tube has been inserted is so slight during the first few days after its removal, that the dressing need be changed only once a day. In cases of primary closure of the bladder wall, the abdominal wound heals by first intention. In every case of prostatectomy, no matter what may be the technique, the urine on the patient's discharge from hospital contains pus and bacteria. The reason for this infection so long after the operation is easily explained.

An investigation was made by J. E. Semple and the writer with the aid of the posterior urethroscope of the changes which take place in the prostatic bed from the fifteenth day after operation

until the sixth week. It was found that the healing process in this region was extremely slow. Even at the end of the sixth week there was still non-union between the mucous membrane of the trigone and that of the urethra. So long as a raw surface persists there must be pyuria. From 2 to 3 months, therefore, elapse before the tissues at the neck of the bladder, following prostatectomy, become normal; if there has been no attempt to cover up the raw surface of the prostatic bed by mucous membrane, as in the blind, or Freyer, operation, this healing process cannot be complete for at least 4 to 6 months. This accounts for the fact that if postprostatectomy obstruction is going to occur, it does not manifest itself for about 6 months following removal of the diseased prostate. We are satisfied that the large majority of patients are discharged from hospital long before healing is complete at the internal meatus. Posterior urethroscopic examination demonstrates quite clearly the importance of bringing the mucous membrane of the base of the bladder as near to the torn end of the prostatic urethra as is possible. The more extensive the area of raw surface uncovered at the time of operation, the greater will be the formation of scar tissue and, therefore, contraction at the bladder neck.

It must be understood that a reconstruction operation such as the writer has outlined in the previous pages can be performed only if it is possible to obtain adequate exposure of the bladder and, also, adequate visualization of the prostatic cavity. For both special retractors and powerful illumination are needed. In a few cases of a second stage prostatectomy, the bladder is so contracted that it is impossible to insert any form of retractor which will give sufficient exposure of the internal meatus without tearing the posterosuperior wall of the bladder and making an opening into the peritoneal cavity. It is obvious that, in this class of case, a reconstruction operation is out of the question.

What are the immediate results from this technique compared with those of the Freyer or blind operation, and the Judd-Thompson Walker open operation? It is found that a reconstruction operation shortens convalescence by about a fortnight.

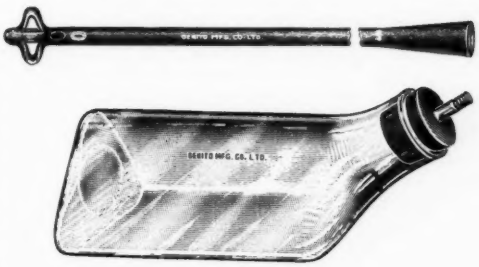


Fig. 15. Catheter. Glass urinal.

This is particularly so when primary closure is practiced. Convalescence in those cases in which a small suprapubic tube is inserted is a little longer. Most noticeable of all the changes is the control of postoperative hemorrhage. The comfort of the patient in not having a large suprapubic tube discharging urine and blood and the absence of an Irving apparatus is too obvious to need emphasis.

The control of sepsis, however, is still an unsolved problem. Surgical interference with a diseased prostate, whether it be by an open operation or by transurethral resection, admits organisms to the bladder which flourish in the wound at the vesicle neck. The larger the raw surface, the greater the infection. It is claimed for the reconstruction operation that sepsis is less pronounced than in the older technique, because the major part of the prostatic bed is covered by mucous membrane. Postprostatectomy obstruction, a remote complication of the blind operation — the Judd-Thompson Walker open method, and transurethral resection —never occurs in the reconstruction technique. In fact, one of the most striking results is the ease with which urethral instruments such as the cystourethroscope can be passed.

Finally, it is stressed that in all those cases in which a complete cure for adenomatous disease of the prostate is indicated, the operation technique should be that described in this paper.

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BURN CONTRACTURES OF THE HAND

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SEVERE burns of the hand and their sequelæ—loss of tissue, infection, scar tissue, and contractures—may so damage a hand that reconstructive surgery is of little or no avail. Early skin grafting will prevent these complications in many instances, thereby eliminating the necessity for difficult and time-consuming, secondary reconstructive procedures.

During recent years, after a group of early burns of the hand and late healed contractures have been treated, some definite conclusions have been reached. Based upon these experiences, rules have been adopted to guide our management of burns of the hand and contractures following such burns.

The importance of a detailed examination of the injured member and a diagnosis of its altered anatomy cannot be stressed too strongly. In early unhealed cases the extent of the loss of tissue is usually recognized easily, but in old healed cases this is not always true. One is frequently amazed at the degree of anatomical distortion which occurs simply as a result of the loss of skin. In the late cases the function of each anatomical structure must be carefully evaluated before the plan of repair is decided upon.

It has been found that the contracted joints of children and young adults, if not directly involved by burns, will usually return to normal function following the release of the contracture. For this reason, contracted fingers in children should rarely be amputated. Elastic traction may be necessary for some weeks or months following grafting, before the final result is achieved. This is particularly so if the contracture is of some years' standing. A return to normal is not the rule in the later decades of life where changes in the joints and permanent loss of function are

Fig. 1. Method of suturing of split graft to hand defect.

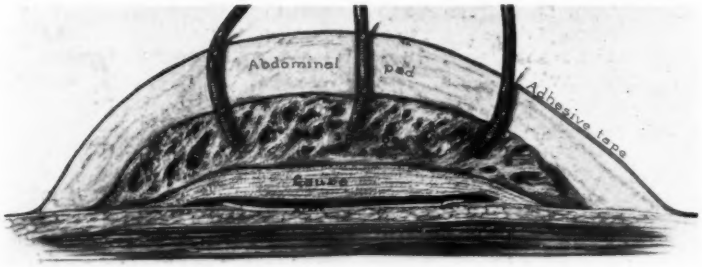

Fig. 2. Method of applying pressure dressing to split graft.

From the Department of Surgery, University of California Medical School.

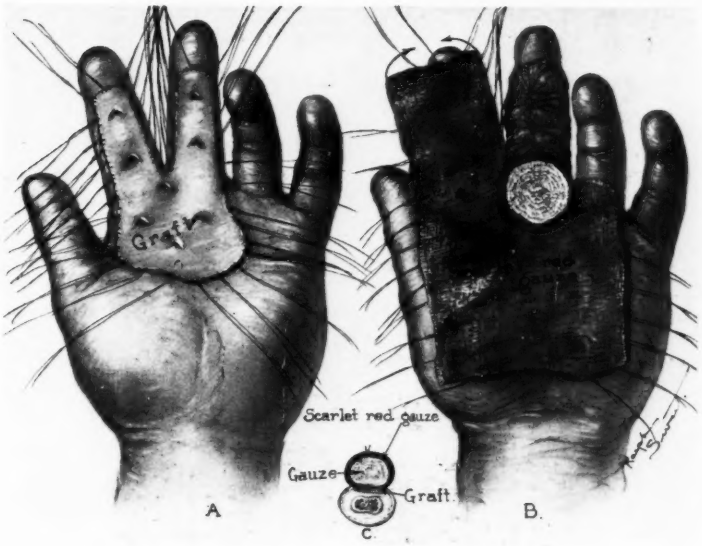

Fig. 3. A, B, C, Application of tied in local pressure for Wolfe grafts.

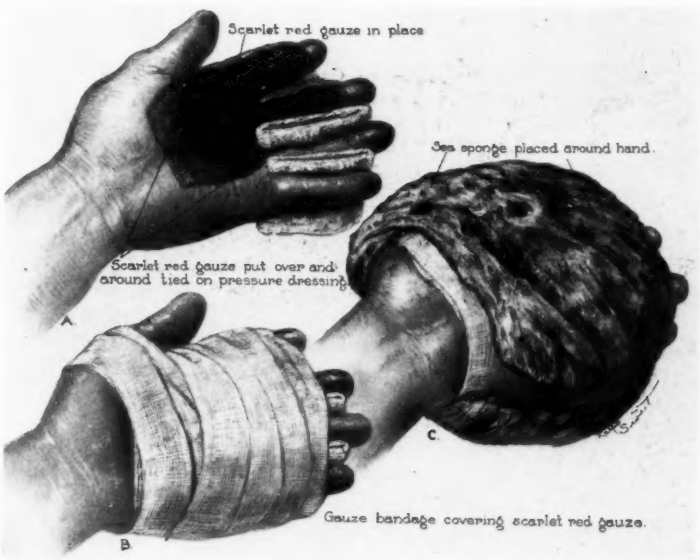
Scarlet red gauze in place
Sea sponge placed around hand.
Scarlet red gauze put over and around tied on pressure dressing
A
C
Gauze bandage covering scarlet red gauze.
B

Fig. 4. A, B, C, Further steps in application of pressure to Wolfe grafts.

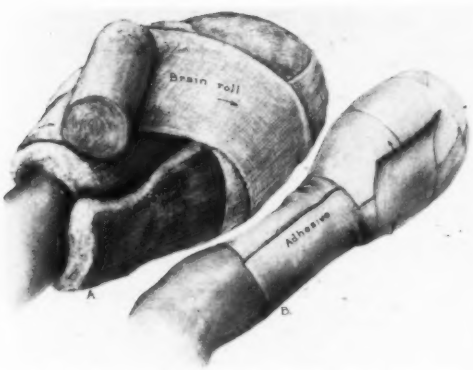

Fig. 5. A, B, Final step in application of pressure to Wolfe grafts.

Fig. 7. A, Early case. No deep structures are involved. Laundry worker. Hand caught in hot mangle. Appearance of hand 4 weeks after burn. B, Six weeks after split grafting.

frequently very marked following a short period of immobilization. In such cases the prognosis must be guarded.

SKIN GRAFTS

The accepted types of skin grafts used in the conditions mentioned are: (1) split skin graft or graft of intermediate thickness (Blair); (2) free full thickness skin graft (Wolfe); (3) dermo-subcutaneous pedicle flap.

The graft introduced and described by Blair comprises from one-half to three-quarters of the thickness of the skin and may be obtained easily in large sheets by means of his suction boxes and knife. This graft is thicker than its predecessor, the Thiersch graft, contracts less and withstands trauma to a greater degree. In most instances it takes, even though the field is not perfectly clean. Its greatest use is in the covering of granulating areas when deeper structures are not involved, particularly on the dorsum of the hand. In children suffering from the loss of large

Fig. 6, A, B. Application of tied in pressure principle for a pedicle flap.

Fig. 8. A, Early case. Deep structures involved. Glass worker. Hand caught in machine. B, Pedicle flap constructed in 2 stages. C, Immobilization spica of sheet wadding, muslin, and adhesive. More comfortable than plaster-of-paris. D and E, Appearance of hand after completion of grafting.

Fig. 8.

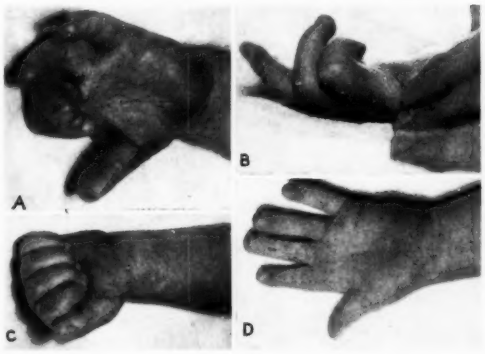

Fig. 9. A, B, Marked flexion contraction of index and middle fingers following burn in a 3 year old child. C, D, Result after excision of contracting scar and application of a Wolfe graft to the defect.

Fig. 9.

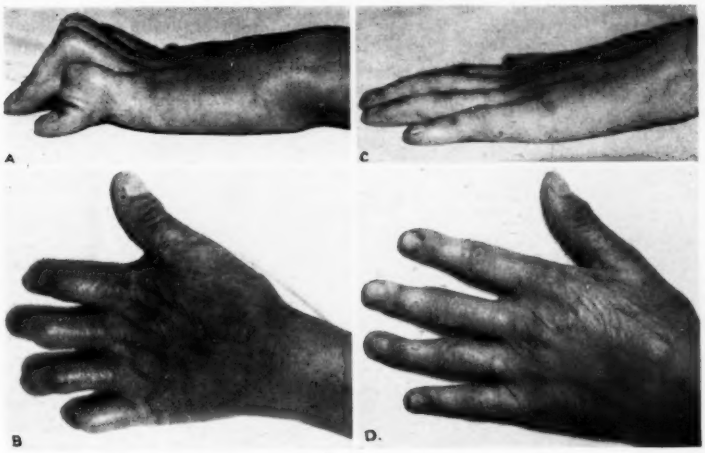

Fig. 10. A, B, Finger flexion contractions of 11 years' duration in a 12 year old boy. C and D, Result 1 year later following Wolfe grafting. Traction was applied for several months.

Fig. 10.

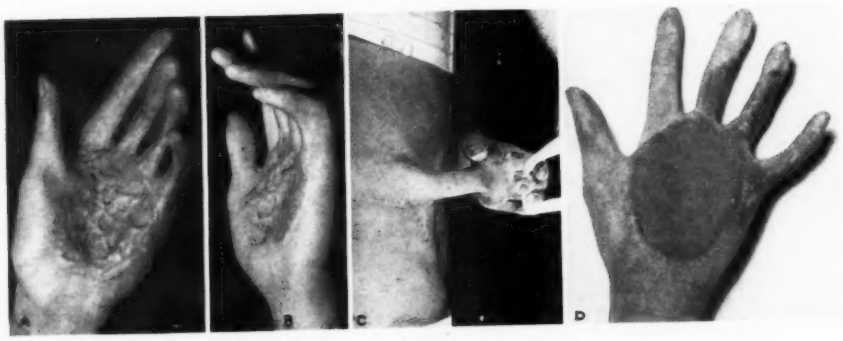

Fig. 11.

Fig. 12.

Fig. 14.

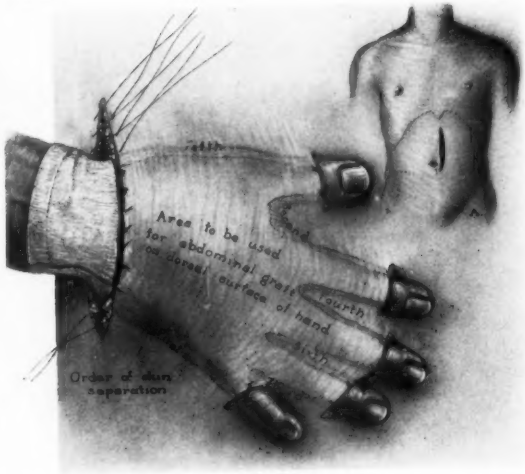

Fig. 15.

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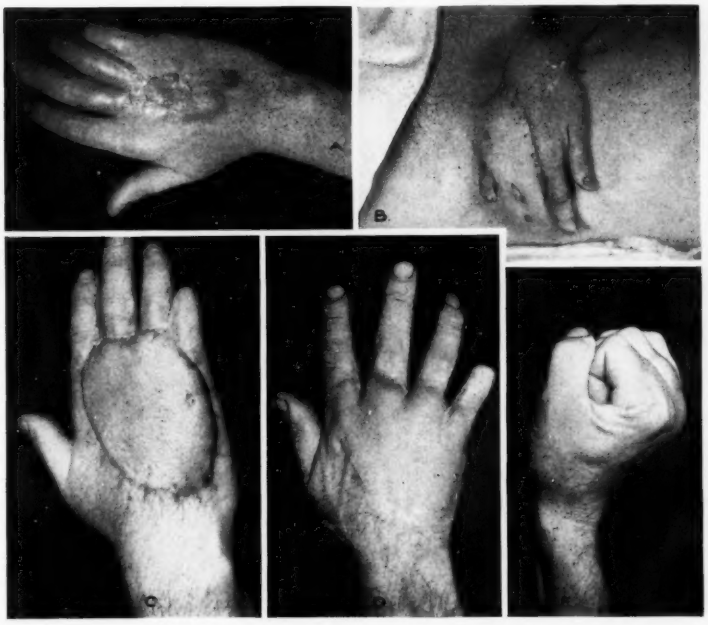

Fig. 13.

areas of skin from the hand, Blair's graft is of considerable value. In marked contractures of the dorsal surface of the hand, for which gradual traction may be necessary, this graft is useful as a preliminary step and may even obviate the use of pedicle flaps. This graft should be used only temporarily on the volar aspect of the hand or fingers, as it does not stand trauma well in this region.

The free full thickness skin graft is functionally and cosmetically better than the split graft. It should be used, however, only on freshly excised or avulsed surfaces, as it will not take in the

Fig. 16.

Fig. 11. A and B, Flexion contraction following burn. Thiersch grafts had been used as primary covering. C, Abdominal pedicle attached to hand at the time of severance. D, Final result.

Fig. 12. A and B, Marked hyperextension contraction following burns from gasoline explosion. C and D, Result after three split grafting operations and traction.

Fig. 13. A, Healed dorsal contraction. B, Hand under small glove flap. C, Fingers syndactylized. D and E, After thinning flap and making webs.

Fig. 14. A and B, Marked diffuse scarring of dorsum of hand preventing flexion. Ideal case for glove type flap.

Fig. 15. Position of abdominal pocket and the order in which the pedicles were resected.

Fig. 16. Demonstrates cotton glove on volar aspect of hand to which two split grafts had been sewed, raw side out. When the hand was placed in the abdominal pocket these grafts covered the base of the pocket.

Fig. 17. A, Hand under glove pedicle. Ulnar pedicle has been cut. B, After cutting and suturing ulnar pedicle. C, After cutting and suturing portions of thumb and index finger pedicles. D, E, F, and G, After completion of case. H, Appearance of abdomen.

presence of infection. It is highly recommended for all small losses of skin, particularly on the fingers. Inexperienced surgeons should use this graft cautiously, as their success will be limited.

For the covering of most large areas, particularly if deeper structures such as muscles, tendons, nerves, or joints are involved, dermosubcutaneous pedicle flaps should be used. This type of graft, properly fashioned, produces the best functional and cosmetic result. Inasmuch as two or more operative steps are always required for its construction and application, the additional surgery must be justified.

OPERATIVE TECHNIQUE

Split grafts (*Blair-Brown technique*). The surface of the donor skin is coated with a thin layer of white vaseline. By means of the Blair suction boxes and knife, a graft of the desired size and thickness is cut, immediately placed on the denuded area, and sewed into place by a continuous horsehair suture. The suture approximates the overlapping edge of the graft to the cut edge of the defect and the central portion of the graft to the underlying granulating area (Fig. 1). "V" shaped incisions are made in the graft for drainage. A pressure dressing is applied, consisting of layers of scarlet red oxyquinoline gauze, moist gauze and moist sea sponges, held in place by adhesive tape. If this type of graft is used on a granulating area of questionable cleanliness, Dakin tubes are included in the dressing, thus permitting the intermittent injection of warm saline solution to keep the dressings warm and moist (Fig. 2). The dressing is changed in from 3 to 7 days, depending on the patient's course and the amount of secretion

which occurs. The pressure dressing is changed as necessary and maintained from 7 to 10 days, varying with the completeness of the take.

Wolfe grafts. One must remember that these grafts are hair-bearing and the donor site must be carefully chosen. A pattern of the defect is made of thin lead plate. The pattern is placed against the donor skin, and its outline is traced. By means of small skin hooks and a small knife, the full thickness of the skin is dissected from the underlying subcutaneous tissue. No subcutaneous tissue should be left on the graft. The graft is fitted accurately to the defect and is sutured into place by interrupted fine silk sutures which are left long. A continuous suture of horsehair is also used to approximate the edges of the graft to the skin. "V" shaped incisions are made in the graft for drainage (Fig. 3, A). A pressure dressing of scarlet red gauze and moist gauze is tied in place by the long silk sutures (Fig. 3, B and C). Further pressure is added by means of additional gauze and moist sea sponges (Fig. 4, A, B, C and Fig. 5, A and B). This dressing is not changed for 10 days. At that time the sutures are removed and pressure dressings, compresses, or grease gauze are applied as indicated.

Pedicle flaps. The abdomen, if unscarred, is usually chosen as the donor area. Two parallel incisions are made with the desired width of skin between them, conforming with Sanger's lines if possible. This flap of skin and subcutaneous tissue between the two parallel lines is raised from its bed, replaced, and resutured. The base beneath the flap may be grafted at the time, if later closure is impossible. After 2 weeks, the distal extremity of the flap is resected, replaced, and sutured. A few days later after its viability has been demonstrated, the flap is raised again and approximated to the defect by interrupted catgut sutures subcutaneously and silk sutures in the skin. The skin sutures are left long, and are tied over a pressure dressing to eliminate dead space and prevent venous stasis and edema (Fig. 6, A and B). This pressure is not disturbed for from 10 to 14 days, when the sutures are removed, the pedicle is resected, and the proximal portion of the pedicle replaced.

For the replacement of large areas on the dorsum of the hand, the gauntlet or glove flap is used. The abdomen is always used as the donor site unless this is contra-indicated. If only the dorsum of the hand is involved, a bi-pedicle flap may be used. If the fingers are also involved, they may be syndactylized under the skin flap and later separated, or smaller pedicles may be fashioned initially as a part of the main flap. If multiple small narrow pedicles are used, only one side should be cut at a time or the circulation may not be sufficient to keep the small flap alive. An interval of from 5 to 7 days is usually sufficient. Tubed pedicles may be used for reconstruction of the hand, but this graft is usually too bulky after its application, requiring additional steps for thinning.

The rules governing our use of these grafts in burns and contractures of the hand may be tabulated as follows:

EARLY CASES

(*unepithelialized*)

Split graft
for cases in which deep structures are not involved (Fig. 7, A and B)

Dermosubcutaneous flap
for cases in which deep structures are involved (Fig. 8, A to E)

LATE CASES

Volar Surface Contractures

Wolfe graft
for fingers, webs, and distal portion of palm (Fig. 9, A to D and Fig. 10, A, B, C, D)

Split graft
for webs

Dermosubcutaneous graft
pedicle flap for palm (Fig. 11, A to D)

Dorsal Surface Contractures

Wolfe graft
for small areas and fingers

Split graft
for hyperextension (Fig. 12, A to D)

Glove pedicle graft
(Fig. 13, A to E and Figs. 14, 15, 16, and 17)

CONCLUSIONS

1. Burn contractures of the hand may frequently be prevented by early and proper skin grafting.

2. A detailed examination of the altered anatomy and a careful evaluation of its function must be carried out before a plan of reconstruction is decided upon.

3. The standard types of skin grafts used for hand surface reconstruction are enumerated.

4. The technique essential for the successful use of these grafts is briefly described.

5. Principles governing our use of these grafts in burns of the hand and contractures due to burns are presented.

TECHNICAL NOTES ON HYPERTROPHIC PYLORIC STENOSIS

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THE Ramstedt operation has been generally accepted as the operative procedure of choice in hypertrophic pyloric stenosis. The apparent simplicity of this procedure is one of its principal dangers. An exact knowledge of the anatomical arrangement of the pyloric ring and the duodenal mucosa is necessary to avoid the accident of opening the duodenum. A small wound through the duodenal mucosa is easily overlooked unless one is aware of the danger of this accident and makes examination for its presence a routine step in the operative management. In dividing the tumor and separating it from the mucous layer, great care must be exercised not to overlook obstructing fibers.

The symptoms and signs of hypertrophic pyloric stenosis need not be recounted here. Palpation of the tumor is a diagnostic sign of importance concerning which a difference of practice exists in various clinics. Some clinicians are reluctant to refer patients for operation unless the tumor can be palpated. Others search for the tumor rather casually, and failure to palpate it is not considered of great importance. Unless palpation for the tumor is done in a methodical manner it will be felt in only a small percentage of cases, but when one is willing to exercise patience it can usually be felt. When palpation for the tumor is practised the infant should be placed on a table and the operator seated to the patient's right with the left hand on the right lumbar area and with the right hand on the anterior wall of the abdomen. The table and chair should be of such a height as to allow the operator's arms to rest in a comfortable position. The hands of the operator should be warm. Under these circumstances, bimanual palpation over the pyloric area will usually enable one to feel the tumor. Should the child be tense and the abdomen be held rigid because of crying, a bottle of warm water should be offered. After this has been taken, palpation should be resumed. The child usually vomits quite promptly and during the temporary relaxation following the throwing up of the fluid, frequently one is able to feel the tumor. If vomiting does not occur the stomach should be emptied by a soft rubber catheter. Relaxation may also be obtained by immersion of the infant in a warm bath.

While palpation of the tumor is not essential to the diagnosis, it is, in some cases, a very

From the Milwaukee Children's Hospital.

Fig. 1. Palpation of the tumor. The tumor can be felt in most instances when the technical details of palpation are carefully observed.

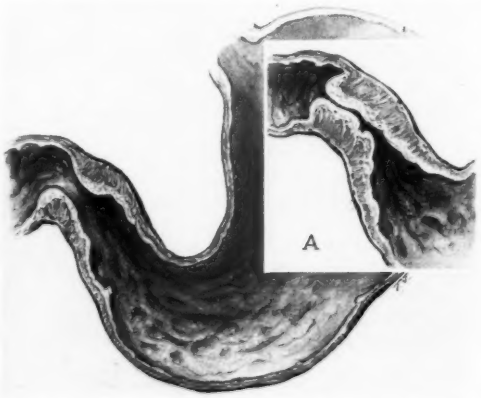

Fig. 2. Semidiagrammatic representation of the arrangement of the gastric, pyloric, and duodenal mucosa illustrating the angulation of the duodenal mucosa by the pyloric ring. A, Cross section of pyloric area in cases of hypertrophic pyloric stenosis illustrating the exaggeration of the angle in the duodenal mucosa produced by the tumor. This drawing illustrates the danger of perforation of the duodenal mucosa in the performance of the Ramstedt operation.

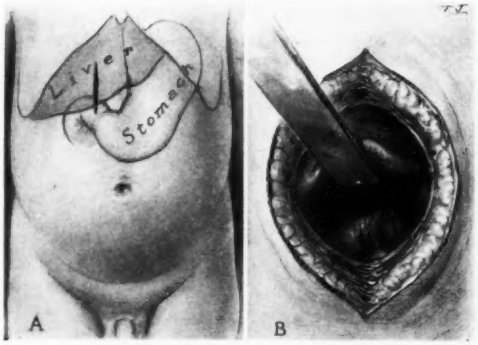

Fig. 3. A, Correct location of incision in hypertrophic pyloric stenosis. B, Exposure of the pyloric area by elevation of the right lobe of the liver.

important diagnostic point, and in all cases demonstration of the presence of a tumor is a source of satisfaction.

Prior to operation the stomach should be emptied by means of a soft rubber catheter. If gastric lavage is done before operation, it is well to allow the catheter to remain in the stomach until the operation is completed. The tendency of these patients to suffer disruption of the wound has been commented on by several writers, but the importance of this tendency cannot be overemphasized. The operative procedure entailed in the Ramstedt type of operation does not necessitate a large incision. An incision 3 centimeters in length is sufficient. This should be located in the

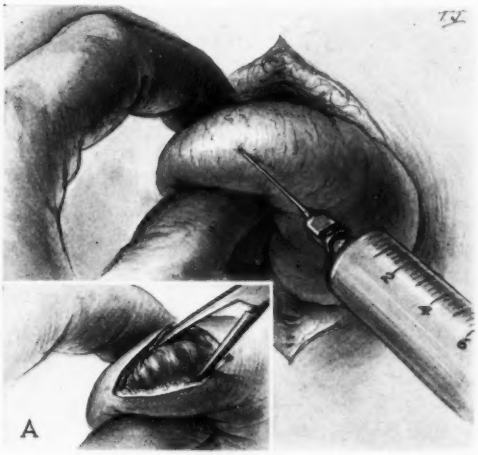

Fig. 4. Injection of the tumor with normal saline solution to facilitate dissection. A, Separation of tumor from mucous layer by stretching with forceps after superficial incision into tumor.

upper right quadrant of the abdomen with at least the upper 2 centimeters above the lower margin of the liver. The incision should be approximately 2 centimeters from the midline. When the incision is made at this point, the liver will protect the abdominal wall during the postoperative stage of healing. Exposure of the

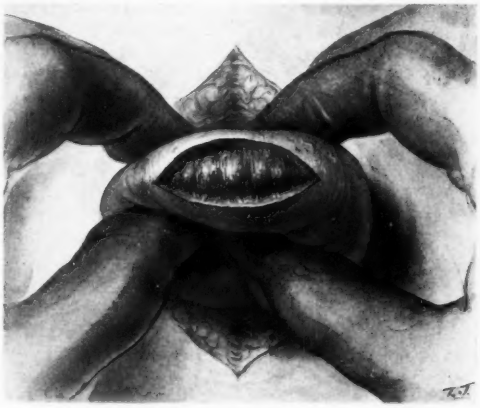

Fig. 5. Examination of entire pyloric area after completion of operation to insure complete division of fibers, and to detect possible injury to duodenal mucosa.

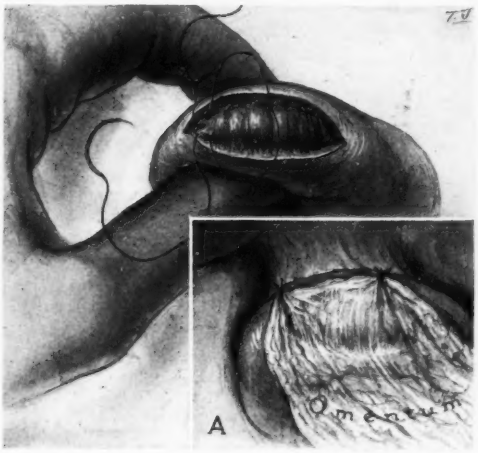

Fig. 6. Closure of perforation into duodenum by mattress suture. A, Omentum sutured in position over pyloric area.

Fig. 7. Photograph of mucous surface of stomach, pyloric area and duodenum in a case of hypertrophic pyloric stenosis, illustrating the reduplication of the duodenal mucosa and its proximity to the peritoneal surface at the caudal end of the tumor.

pylorus is easily effected by the gentle elevation of the lower margin of the right lobe of the liver by means of a small straight blade retractor.

When the stomach is identified, a small portion on the anterior wall should first be brought into the wound and then drawn to the patient's right. When the stomach is then brought over to the left, the pylorus comes easily into view. The tumor as well as the adjacent duodenum is held in the left hand between the thumb and the index finger.

In patients who have a marked degree of obstruction, the tumor is frequently somewhat edematous. Such tumors are easier to separate from the mucosa and bleed less than do those in which there is no edema. Acting on this observation, we have injected from one to 1½ cubic centimeters of water or normal saline solution into the tumor in most cases, and have found that this facilitates the ease with which separation of the muscularis from the mucosa can be accomplished. Bleeding from the cut edge should always be observed, and if it is found that any points bleed actively they should be controlled by means of ligation.

A thorough knowledge of the anatomical arrangement of the duodenal mucosa at its junction with the pylorus is of great importance when one is performing the Ramstedt operation. The arrangement has been commented on by several writers and is illustrated in standard anatomical textbooks, but has not been sufficiently emphasized (1). The pyloric ring produces a sharp constriction of the mucosa of the stomach and duodenum. There is practically no danger of puncturing the gastric mucosa, as one separates the mucosa from the mucous membrane upward on the gastric side. The duodenal mucosa, which has been constricted by the pyloric ring, approaches the wall of the duodenum at a right angle or at an acute angle which points toward the stomach. For this reason, in approaching the duodenum in the separation of the tumor from the mucosa, one must exert extreme care not to puncture the membrane, the angle of which is quite superficial at this point. The pyloric tumor not infrequently has pushed into the duodenum so that its anatomical relation to the bowel is quite similar to that of the cervix to the wall of the vagina.

On completing dissection of the tumor and separation from the mucous membrane by spreading with a forceps, one should carefully examine the area for possible puncture of the duodenum. This is best done by holding the duodenum and the tumor between the thumb and index finger of the left hand and by holding the stomach just above the tumor between the thumb and index finger of the right hand. By gently approximating the two hands one can exert sufficient pressure to demonstrate any damage to the mucosa.

Puncture of the duodenum, however, is not a serious complication if one notes that it has occurred and repairs the damage properly. The accident is easily overlooked and we have seen instances in which this has occurred. The puncture wound may be small but it can be identified by the everted mucous membrane and usually a small bubble of bile-stained fluid can be expressed. Montgomery has suggested that the area suspected of puncture be moistened with normal saline solution. Pressure upon the duodenum, if it is punctured, will produce small bubbles which enable one to identify a very small opening. When the duodenum is perforated the defect should be closed by one, or at the most, two simple mattress sutures of No. 0 chromic catgut. By using a Connell type of suture the margins can be inverted. The area should then be covered with the omentum which is fixed in place with several stitches.

We prefer ether anesthesia by the open drop method in these cases. The operation does not consume much time and a small amount of ether affords complete relaxation. We have never regretted its use. The operation can be performed by local infiltration anesthesia, and this method is preferred by some surgeons. The relaxation afforded by this method is not as satisfactory as

that which is secured under ether anesthesia and in several instances, during the process of operation we have noted untoward symptoms such as mild convulsive seizures, which we have attributed to the novocain solution. In no instances have these symptoms been followed by serious complications.

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EXTRAPERITONEAL IMPLANTATION OF THE COLON

One-Stage Resection for Carcinoma

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In cancer of the colon a method of extraperitoneal resection is employed in a one-stage operation, which permits adequate excision and avoids both peritonitis and fistula. Because of the production of fecal fistulas two or more stage operations are repugnant both to the patient and the physician (1, 2). This technique is applicable only to certain selected cases of carcinoma of the cecum, ascending and descending colon, and sigmoid. Individual variations in the technique, necessitated by the position of the tumor, may suggest themselves to the surgically qualified reader, and possibly he may desire to extend its limitations.

The advent of modern roentgenological technique and the wider dissemination of popular knowledge concerning cancer have aided in earlier diagnosis, and it is only through early diagnosis that such an approach as is herein described can be used.

An accurate localizing diagnosis must be made before the onset of total obstruction, otherwise preliminary colostomy or enterostomy is necessary. The patient is put upon a liquid diet for 5 or 6 days. The intestinal tract is thoroughly cleaned out and decompressed by mild catharsis prior to operation.

The steps in the operation are shown in the illustrations.

An incision is made from the costal margin on the left side, following the lateral margin of the left rectus muscle, downward to about 2 inches above Poupart's ligament (Fig. 1, A). The external oblique aponeurosis is incised and the aponeurosis is split longitudinally just lateral to the lateral border of the rectus. This incision of the external oblique aponeurosis is carried downward to a point just above the external inguinal ring. This division of the external oblique aponeurosis is done with scissors and follows the lateral margin of the rectus in the whole length of the skin incision (Fig. 1, B).

The internal oblique and transversalis muscles are split transversely in the direction of their fibers, as in the McBurney incision, at a point opposite to the anterior superior spine of the ilium. This is to afford access to the retroperitoneal line of cleavage between peritoneum and musculature of the abdominal wall. Then the abdominal wall is carefully separated from the peritoneum with the hand, working upward and

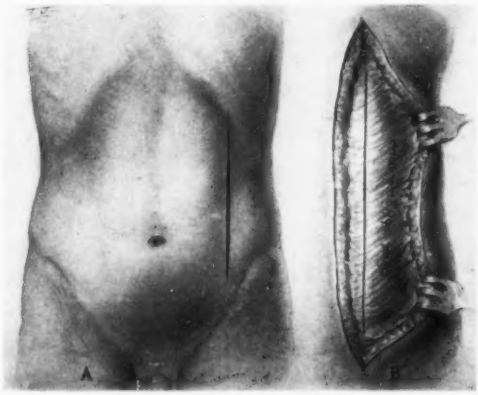

Fig. 1. A, Line of incision; B, division of external oblique aponeurosis.

From the Surgical Service, Illinois Central Hospital.

Fig. 2. A, Separating of abdominal wall from peritoneum; B, peritoneum exposed.

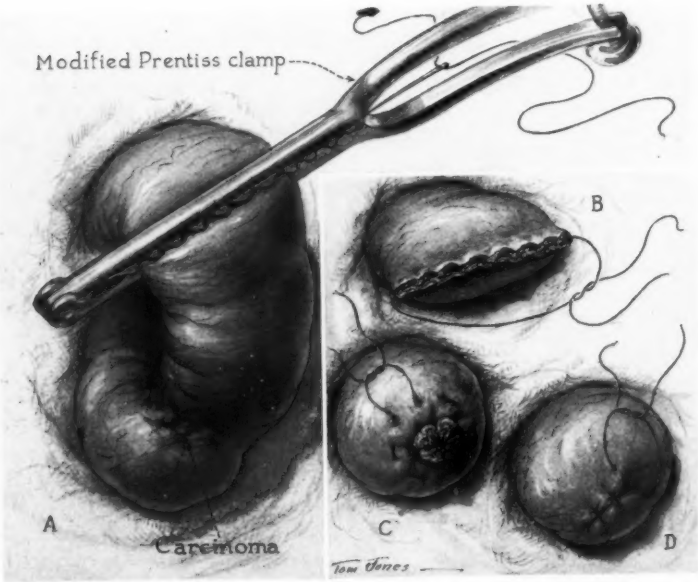

Fig. 3. A, Colon withdrawn through peritoneal incision and tumor located, Prentiss clamp applied; B, C, and D, further steps in removal of tumor and closure of stumps.

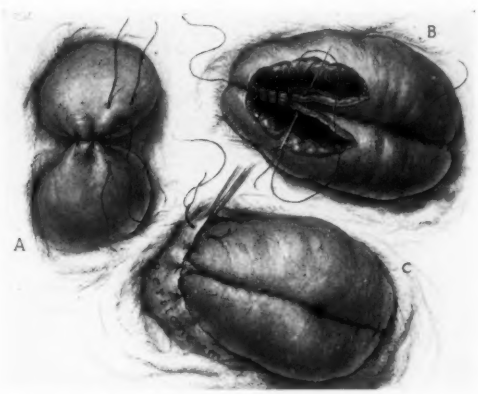

Fig. 4. A and B, Steps in lateral anastomosis; C, complete isolation of the extruded anastomosis from peritoneal cavity.

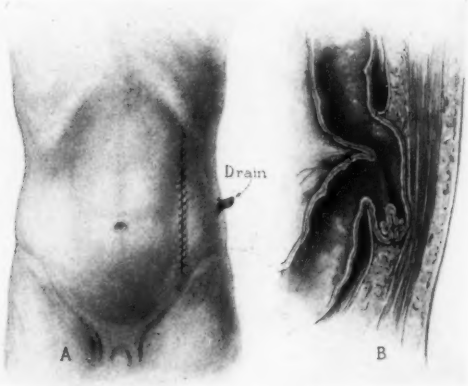

Fig. 5. A, The abdomen is firmly closed in layers and stab wound in side for drain; B, sectional view. Care is taken to prevent leakage.

downward from this split in the internal oblique and transversalis muscles. Then with scissors the transversalis and internal oblique are cut again, paralleling the rectus margin. This longitudinal division of the internal oblique and transversalis is also carried parallel to the skin incision, equaling the skin incision in length, and parallel to the division of the external oblique aponeurosis. This exposes unopened peritoneum. The peritoneum must be carefully protected against injury, particularly in the upper part of the incision. It is more firmly attached above the level of the umbilicus than it is below it (Fig. 2, A and B).

With this large incision and complete separation of the fascia and muscles of the abdominal wall access is obtained to the retroperitoneal space behind the colon, and in relation above to the kidney and below to the retroperitoneal tissue, fat, areolar tissue, and muscles of the true and false pelvis. Extraperitoneal separation of the colon from the posterior parietal wall is done by blunt dissection with the fingers and with gauze. This exposure of the peritoneum laterally permits palpation of the bowel and determination of the tumor mass, its site and extent, prior to incision of the peritoneum.

When carefully done, the separation of the colon posteriorly is easy and bloodless. When extended toward the midline the ureter should be identified.

The tumor mass to be resected is identified through the peritoneum by palpation and the site of its extrusion is chosen. An incision into the peritoneum, about 2 inches in length, is made lateral and anterior to the position of the tumor, and the portion of the colon to be resected is withdrawn through the peritoneal incision and isolated. With proper mobilization and free extraperitoneal dissection the descending colon is accessible in most of its length. The field is properly protected with gauze. Examination is made for local lymph glands and the extent of the tumor mass is further ascertained. The site of resection is then chosen (Fig. 3, A).

The tumor mass as drawn through the peritoneal incision is excised between Prentiss clamps with the electro cautery. A needle threaded with

Fig. 6. Photograph of specimen removed.

Fig. 7. Roentgenogram before operation.

Fig. 8. Roentgenogram after operation.

double linen is passed through the Prentiss clamp and tied. A pursestring invaginates the tied ends, and this pursestring is buried by additional sutures, further invaginating and protecting the stump from opening. Both ends are carefully sealed and then approximated to each other (Fig. 3, B, C and D).

At a distance of about 1.5 inches from the blind and sealed stumps a lateral anastomosis, colon to colon, is done with two layers of linen (Fig. 4, B).

The peritoneum is now sutured to the bowel proximal to the area with interrupted linen sutures, closely approximating peritoneum to bowel serosa and completely isolating the extruded anastomosis from the peritoneal cavity about 1 inch proximal from the side-to-side anastomosis (Fig. 4, C).

A large free stab wound is made in the flank just above the iliac crest, and a fenestrated rubber tube drain placed below the blind stumps. The abdomen is firmly closed in layers (Fig. 5, A).

The blind ends are sutured together (8) in the hope of better maintaining the physiological integrity of the bowel, with consideration to the peripheral nervous mechanisms within it, as well as its support from the abdominal wall, and to further prevent leakage (Fig. 5, B).

The extrusion of a blind stump was first suggested and called the thumb method by Bloodgood (3), and used successfully by him. His approach was an intraperitoneal one and the anastomosis was left intraperitoneally.

The side-to-side anastomosis was used because of previous failures in attempts at end-to-end anastomosis. While fistulas have developed in end-to-end anastomoses by this extraperitoneal method they have remained extraperitoneal and without systemic repercussion.

Considering the mobility of the colon from an embryological and anatomical point of view (7), and the distribution of its blood supply from central sources in a manner permitting considerable elasticity, it would seem that an operation requiring considerable mobilization is morphologically sound.

The extraperitoneal approach is an old one, antedating the days of antiseptic surgery by its use in the older cesarean sections and in the preantiseptic methods of approach to carcinoma of the large bowel. The later uses of the extraperitoneal approach have been mostly in modern cesarean section and in work on the kidney and ureter, such as done by Hugh Cabot.

The approach seems a logical one in properly located and selected tumors of the bowel. Properly speaking, it is not entirely extraperitoneal as the peritoneum is opened for the delivery of the tumor. Practically, by exclusion of the operative field from the peritoneal cavity, the operation can in this sense only be called extraperitoneal. It is

seen that none of the features of this technique are new, yet the combination of them has resulted in a satisfactory approach. This extraperitoneal position of the anastomosis is of great advantage in avoiding peritoneal infection.

The two-stage operation suggested by Heinecke and published by Oscar Bloch in 1892 was popularized by Mikulicz and has superseded the one-stage operation as a measure of safety in certain cases of carcinoma of the colon. Adopted by Bruns and Mayo (9) it is now called the Mikulicz-Bruns-Mayo operation. The production of slow closing fistula adds to the difficulty of the operation. One-stage intra-abdominal operations by lateral anastomosis are often chosen in preference to the Mikulicz procedure. In no other circumstance is surgical judgment as to the type of operation more difficult (3). It is to be hoped that the method may be an addition to those at our disposal.

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A WALKING IRON FOR IMMEDIATE USE ON WET PLASTER CASTS

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THE use of walking irons on fractures of the lower extremities is advocated because of increased comfort and decrease in economic loss to the patient; and because of the prevention to a great extent of muscle atrophy which in turn means a decrease in the time necessary for the return of maximum function. This therapy is best suited to fractures of the ankle in which the weight bearing is not greatly interfered with, such as fractures of one or both malleoli or fracture dislocations with the posterior portion of the tibia broken off. This method may also be applied in some fractures of the foot, and in fractures of the long bones or of the os calcis if Steinmann pins or Kirschner wires are properly incorporated in the plaster so as to bear the weight. Many men who are convinced of the benefits of walking on a fractured extremity, when the nature of the fracture permits, do not generally use walking irons because of the technical difficulties involved. In the hope that this type of therapy will be better applied and further popularized, this article introduces a modification of the old type walking iron which overcomes some of the technical difficulties of application as well as provides greater safety to the patient.

To my knowledge all walking irons, whether the loop, crutch-tip, or skate type, are now made of the same weight material throughout. Any such walking iron of sufficiently heavy material to carry the patient's weight is of necessity difficult to bend, and, therefore, the accurate fitting of such an iron to a cast requires patience, skill, and labor, especially if proper bending irons are not available. The iron must not be applied until after the cast is well hardened so that pressure caused on the cast by the necessarily imperfect fit of the iron will not be transmitted through onto the extremity. The failure to observe this rule and the failure to use unpadded plaster are the principal causes for a great deal of pain and not a few of the pressure sores produced by the use of walking irons.

To minimize these difficulties, we have devised a walking iron with flexible upright portions, which we have used with universal success the past 18 months (Fig. 1). The flexible uprights fit themselves to the curves of the plaster when applied and though they are thin and very flexible, being made of spring brass, they are able to bear weight because they are held tightly between the layers of the plaster cast; and perforations, made with a nail from the inside out through these uprights, keep them from slipping. The stirrup portion is of rigid duraluminum and wide enough so that it does not impinge on the plaster over the malleoli. On the stirrup is a metal peg covered with a crutch tip which rotates in a simple swivel joint facilitating rotation without much friction. This makes walking easier and the rubber crutch tip wears much longer than if the peg is fixed. We believe patients are less apt to slip or trip on a swivel type crutch tip than on a loop or skate type of iron. The construction of this walking iron is simple and inexpensive. It does not rust and may be used time and time again.[1]

This iron is applied according to the method of Boehler[2] after local anesthesia is applied at the site of fracture. If the edema is not marked, it is massaged away so as to allow accurate molding of the plaster. If edema is marked some other form of immobilization is used until the edema subsides. It must be borne in mind that the quickest and easiest way to get rid of swelling is to reduce the fracture. This is usually done with the patient sitting on a table with the injured extremity being supported by the operator's knee (Fig. 2) and the foot held in the optimum position. The patient's other foot is placed on a stool for balance. A piece of stockinette about 6 inches wide is slipped on and placed just below the knee; and over the lower portion of this, fastened with adhesive, is placed a 2 inch strip of thin felt (Fig. 2). A very wet plaster strip 4 to 6 inches wide, about six layers thick and of a previously measured length is then placed stirrup fashion around the foot and leg, directly on the unshaven skin (Figs. 3 and 4) and held in place by a single layer of gauze bandage so that the operator may mold the plaster about the bony

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[1]This walking iron may be purchased from the Brace Shop of G. A. Guilford, 5700 Thackeray Ave., Cleveland, Ohio, and the DePuy Co., Warsaw, Indiana.

[2]Boehler, Lorenz. The Treatment of Fractures. 4th ed., pp. 430–434, Translated by Ernest W. Hey Groves. Baltimore: William Wood & Co., 1935.

Fig. 1.

Fig. 2.

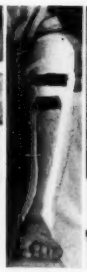

Fig. 3.

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Fig. 10.

Fig. 11.

Fig. 1. Walking iron with flexible uprights, rigid stirrup, and swivel crutch tip.

Fig. 2. Position of patient and operator for application of unpadded plaster leg cast. Local anesthesia. Stockinette and felt in place.

Fig. 3. Anterior view of stirrup plaster placed directly on skin.

Fig. 4. Lateral view of stirrup plaster applied directly on the skin.

Fig. 5. Stirrup plaster held in position by gauze bandage. The plaster is being molded about the ankle.

Fig. 6. Posterior splint. Note notching at the heel.

Fig. 7. Circular plaster applied over splints.

Fig. 8. Walking iron in long axis of leg applied on wet cast.

Fig. 9. Anterior view of iron in position. Note space between the rigid portion of iron and plaster over malleoli.

Figs. 10 and 11. The cast completed and iron in position.

prominences with the flat of the hands without creases or wrinkles (Fig. 5). After this stirrup splint has set well enough to hold its shape, the supporting gauze bandage may or may not be cut and removed and a posterior splint of wet plaster 4 to 6 inches wide and about six layers thick is applied, the strip being notched at the bend in the heel so as to lie smoothly (Fig. 6). It is absolutely essential that these strips be applied while wet and soft. If they are not absolutely soft, uneven pressure with its sometimes disastrous results will follow. The circular plaster bandage is now applied, care being taken that it is absolutely smooth over the anterior portion, making any reverses or turns over the previously applied splints (Fig. 7). This plaster is quite tightly applied, especially over the upper portion of the cast.

Without delay the walking iron is put into position exactly in the weight bearing line (Fig. 8). It will be noted in the anterior view (Fig. 9) that the heavy duraluminum portion of the splint is wide enough to avoid pressure on the malleoli. If the extremity is supported as shown in Figures 8 and 9, care must be taken that the patient does not put much weight on the stirrup; it is usually best to continue supporting the foot as was done when the splints were applied. The stockinette at the upper edge of the cast is now turned down so as to make this edge smooth. With the walking iron held in position, one or two plaster bandages are now applied over it, thus molding the flexible uprights to fit the contours of the cast without uneven distribution of pressure (Figs. 10 and 11). Care must be taken to cover also the rigid portion of the uprights. The cast is trimmed exactly at the base of the toes so that the toes may be moved freely; care must be taken not to trim the cast proximal to the base of the toes or

painful swelling of the dorsum of the foot may occur. The plantar portion of the cast is left long to protect the toes.

This completes the cast, but the patient should remain in bed with the leg elevated for 24 hours. After this period, if no abnormality is noticed, it is safe to begin weight bearing; if there are signs of poor circulation to the toes, the patient should remain in bed with the leg elevated until circulation is adequate, or if severe, the cast should be removed and reapplied when edema has subsided. If the cast and iron are properly applied on properly chosen cases, in which the fracture can be accurately reduced, there should never occur painful and dangerous pressure areas. If pressure pain does occur, however, the cast must be removed. Walking is sometimes not comfortable for the first 2 days until the patient has become accustomed to the apparatus. This accommodation occurs rapidly, especially in children and young adults, and all are grateful to have a walking cast instead of having to hobble about on crutches, since most of them go about their business with surprisingly little limitation of activity.

The cast if applied as here described is comparatively light. This walking iron weighs 14 ounces and the average total weight of cast and iron is 3½ pounds when dry. Likewise, with this type of apparatus the circumference of the leg is not greatly increased and therefore it is not cumbersome.

After having used various types of light padding we are completely satisfied that unpadded plaster properly applied is more comfortable and less dangerous to the patient when walking irons are to be used. Padding tends to wad up and wrinkle with consequent pressure areas and discomfort, and the fragments are more apt to slip out of position. In unpadded plaster there is practically no friction within the cast.

The removal of this skin-tight plaster is not difficult. The hair on the leg changes about every 3 weeks so after this interval there is no pain on removal of the cast. Usually, if convenient, we have the patient soak the cast in water for an hour or two, after which it is easily cut off. The cast is usually not removed until the fracture is quite well healed because the walking on the fractured extremity is physiotherapy in itself. Muscle atrophy is minimal. In many cases the patient puts on a shoe and walks immediately after the plaster is removed, with surprisingly little discomfort or swelling.

SUMMARY

A new type of walking iron, with flexible upright portions, a rigid stirrup, and a swivel type crutch tip is described.

This walking iron is immediately incorporated in a wet plaster cast without the danger of causing pressure areas.

The technique of applying an unpadded plaster boot with this walking iron is described.

SURGICAL ASPECTS OF NEUROGENIC TUMORS OF THE ABDOMEN

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NEUROGENIC tumors of the abdomen encountered in general surgery have seldom been diagnosed accurately before exploration. These neoplasms have no pathognomonic characteristics by which they may be readily recognized. The conjectural diagnostic aspects are not settled even by exploration, as the surgeon usually bases his opinion upon his impression of the gross appearance of the tumor and upon resemblance with other neoplasms with which he is familiar. Competent histopathological reports disclose the identity and nature of the tumor, which usually intrigue the surgeon heretofore unfamiliar with these rare neoplasms.

The present study is based upon clinical and surgical experiences with two types of neurogenic tumors: (a) schwannoblastoma (neurinoma) and (b) retroperitoneal sympathicoblastoma (neurocytoma).

SCHWANNOBLASTOMA (NEURINOMA)

José Verocay was the first to describe these tumors and differentiate them from neuromas on histological grounds. He coined the term "neurinoma" in 1910. Verocay and Antoni were of the opinion that these tumors originated from the sheath of Schwann, or from the cellular ancestors of the sheath, designated by them as lemmoblasts.

The terminology of this type of tumor is varied and may be explained as follows: (a) gross diagnosis without histological verification, or inaccurate histological interpretation; (b) divergence of opinion among histopathologists and personal preference of terminology.

This accounts for such terms as schwannoblastoma, neurinoma, solitary neurofibroma, perineural fibroblastoma, peripheral glioma; sarcoma, fibrosarcoma, fibromyxosarcoma, malignant leiomyoma. A more definite study of these neoplasms will tend to reduce the terminology to that most frequently used in medical literature, i.e., neurinoma and schwannoma, or schwannoblastoma.

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Arthur Purdy Stout objects to the term neurinoma because it suggests nerve fiber tumor, when in reality the tumor originates from the sheath of Schwann. F. H. Vizetelly, editor of the *New Standard Dictionary*, prefers neurilenoma instead of neurinoma.

The scarcity of these neoplasms may be inferred by the absence of mention in collective reviews of benign neoplasms of the stomach. Balfour and Henderson, who reported 58 cases of benign tumors of the stomach from the Mayo Clinic, do not speak of schwannoma. Likewise, Eliason and Wright in a discussion of benign tumors of the stomach failed to mention this type of tumor.

Schwannoblastoma usually develops from the stomach wall, although it has been encountered in other tissues, such as appendix, extremities, upper respiratory organs, tongue, eye, and orbit. Schwannoma in the first portion of the duodenum was described by Lemonnier and Peycelon. Peretz reported a case of neurinoma of the appendix. Dyggve Petersen reported 20 cases of intrathoracic neurinomas, all occurring in women and shown by x-rays to be in the paravertebral area.

Etiologically, there is no definite accounting for the origin of these tumors. The factors which initiate these tumors and spur them on to growth are shared by the growth of tumors in general. However, some pertinent and highly suggestive observations have been made to the effect that nerve proliferation is frequently observed in inflamed gastric mucosa on the edge of an active or cicatrizing ulcer (Masson). Jentzer found small neurinomas in the callous portion surrounding small gastric ulcers. Okkels observed marked proliferation in the nerves of the gastric walls surrounding the ulcer margin, which he defines as neurinoma scar. Similar observations have been made by Askenazy in gastric ulcers, the wall of a previously inflamed appendix, or in chronic obliterative appendicitis. These proliferative processes may attain neoplastic proportions and, thus, may explain in some measure the neoplastic origin from a simple proliferative process.

Since most of these tumors originate in the myenteric plexus of Auerbach, it may not be amiss to review briefly the arrangement of the nerve plexuses of the stomach wall. There are in

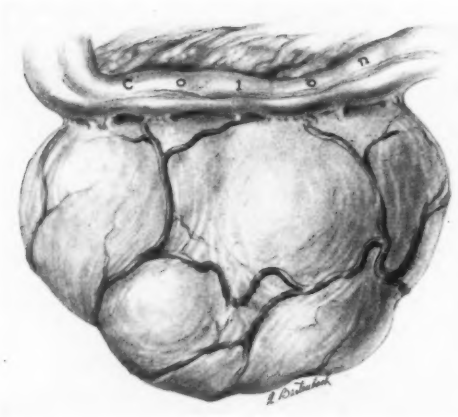


Fig. 1. Tumor mass as seen by artist at operation.

the stomach and intestines two sets of nervous plexuses: one is located in the submucous plexus (Meissner), the other between the annular and longitudinal muscular planes of the stomach, with clusters of ganglion cells at nodal points (Auerbach). Schwannoblastoma originates in the myenteric plexus of Auerbach, from the sheath of Schwann. Since the nerve sheath has a dual origin, ectodermal and mesodermal, the histological picture of schwannoma may be classified either as ectodermal (v. Recklinghausen) or mesodermal (Verocay). Penfield, in American literature, rejects the ectodermal origin.

Schwannoma is usually a small tumor, but may attain a large size if there is anatomical chance for expansion. As a rule, it is single, exceptionally multiple. Occasionally, it is associated with multiple cutaneous fibromatosis (von Recklinghausen's disease). Schwannoma has a preference for centrally located tissues, whereas neurofibroma prefers the periphery. Schwannoma often invades the spinal cord roots, especially the posterior. It is often found in the root of the acoustic nerve, especially its peripheral branch (Henschen, Cushing). The tumor is well encapsulated, and while it may displace other tissues, it does not infiltrate. It is soft on cut surface, its color varying from brown to gray. Here and there, areas of cystic degeneration with colored fluid and cystic spaces; brownish spots, evidence of old hemorrhage. Gastric schwannoma grows peripherally and if it encroaches upon the lumen of the stomach it does not, as a rule, ulcerate the gastric mucosa. In Gosset's collection of 42 cases of gastric schwannoma, there was no involvement of the mucosa in 21 cases. Some cases, however, ulcerate the mucosa and cause hemorrhages, as it occurred in the case of Lemonnier and Peycelon. In the case of Dupuy the neurinoma caused both ulceration of the mucosa and perforation of the gastric wall. The tumor may be situated on the anterior wall, either intramurally or subserous.

Schwannoma is essentially a benign tumor. It is well encapsulated and, while it may recur *in situ*, it does not as a rule become malignant or metastasize. The tumor is often pedunculated, grows slowly, and does not impair the patient's health, which explains its long latency.

In the case of Paul Carnot, there were metastases in the heart. Kurt Denecke reported 2 cases of schwannoma from the Pathological Institute of the University of Freiburg, one in the duodenum, the other in the stomach, both of which were malignant and metastasized in the liver.

Clinically, schwannoblastoma of the abdomen is characterized by a long period of latency and the presence of a mass in the upper abdomen located medially. There is no pain or discomfort, except if there is interference with neighboring organs by sheer pressure. In Gosset's collection there were no gastro-intestinal symptoms in 27 cases. However, in a number of cases the patients had gastro-intestinal symptoms which simulated gastric ulcer and in a few, a penetrating ulcer. In the intestines, schwannoma is more apt to ulcerate and cause intestinal hemorrhages.

The presence of a mass in mid-epigastrium, expressed in terms of gastric ulcer, in association with von Recklinghausen's disease is highly suggestive of schwannoblastoma.

Antoni, taking into account the histological pattern, describes two types of schwannoblastoma:

Type A (Antoni). *Fibrillary type*, made up of long, slender fibers, either straight or undular, regularly grouped; cells with elongated nuclei arranged in palisades; whorls, similar to those seen in meningiomas. Type A is a neuronomatous structure at the height of its development.

Type B (Antoni). *Reticular type*, made up of fibers and cells without orderly arrangement, cysts and spaces filled with fluid. Type B indicates retrogressive changes and degenerative phenomena and is a sort of jellification of Type A.

Both types show unequal distribution of capillaries with evidence of dilatation, thrombosis, or hemorrhage.

In addition to the diagnostic earmarks given, x-ray pictures may show a round shadow with a depressed area, suggesting a penetrating ulcer. In the differential diagnosis one has to consider

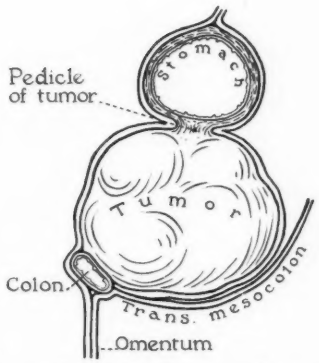


Fig. 2. Sagittal section through stomach, tumor, and colon.

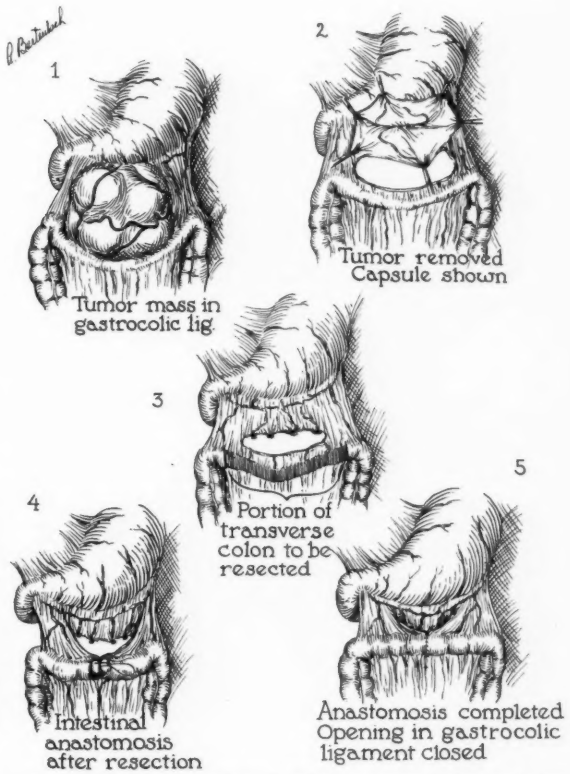


Fig. 3. Relation of tumor to neighboring organs, before and after removal.

all of the median epigastric masses or tumors, such as indurated pancreatitis, pancreatic cysts, also some of the more lateral masses, such as movable kidney, enlarged spleen, hydrops of the gall bladder, hydatid cysts of the liver, and retroperitoneal tumors.

The indications for operation are: the presence of a tumor mass, vague symptoms which do not come within the range of well defined gastro-intestinal clinical entities, with evidence of mechanical interference of function or the presence of hemorrhages.

The removal of these tumors offers no difficulties. The tumor shells out well and the pedicle, often present, may be either ligated or sutured. If there is encroachment upon the lumen, a segment of the stomach may have to be removed and subsequently repaired.

SUMMARY HISTORY OF CASE OF SCHWANNOBLASTOMA

Mrs. I. G., age 46 years, was admitted to Cook County Hospital, Chicago, May 17, 1937, and discharged July 17, 1937.

For about one year patient complained of loss of appetite. She experienced a sense of fullness in the pelvis. She noticed an abdominal mass and an enlargement of the abdomen for about 1 year. She was free of gastro-intestinal symptoms except for occasional fullness after meals; no nausea or vomiting. She had a daily bowel movement. She had frequent urination but no pain. There was no loss of weight.

Examination revealed a slender woman in a state of fair general nutrition. Examination of the heart and lungs revealed nothing abnormal clinically. The abdomen was large and slightly tender to pressure, especially on the right side. There was an old operative scar in the middle line between the umbilicus and the symphysis pubis. A large mass, hard and fixed and filling the entire right half of the abdomen, could be readily palpated. There was a fluid wave present. Vaginal examination revealed a freely movable cervix, painless to movements. The fornices were free of masses or infiltration. Patient's menses ceased in 1933.

Patient had a gynecological laparotomy performed in 1934 at which time a 6 pound tumor had been removed. She states that at the time there was a great deal of fluid in the abdomen. She was never told what the nature of the tumor was.

X-ray investigation read as follows: moderate amount of opacity in the lower two-thirds of the abdomen. There is a scoliosis of the lower dorsal and upper lumbar spine. From the x-ray standpoint there was an extrinsic pelvic mass producing pressure defect on the pars pylorica of the stomach. There is also a rather constant irregularity of the lesser curvature of the stomach suggesting an intrinsic gastric lesion.

The clinical impression of the interne who wrote the history was: ovarian tumor—probably Krukenberg tumor; ovarian cyst; gastro-intestinal malignancy.

Surgical exploration. A large mass was found, the size of a large pumpkin, over which was plastered on the lower

Fig. 4. Schwannoblastoma. Histological appearance of segment of tumor.

border and on the outer surface a segment of transverse colon in horseshoe fashion. The mass was lobulated and had very large, tortuous veins on its surface. On further investigation it was disclosed that the mass was located in the gastrocolic omentum being attached rather firmly to the stomach wall at one point. In the attempt to free the mass from the surrounding structure, there was a good deal of hemorrhage from the greatly distended veins. The gall bladder came close to the outer margin of the tumor, but was not attached to it. The walls of the gall bladder were very thick. As a matter of fact, the gall bladder was a solid mass (Fig. 1).

Although the situation looked somewhat spectacular at first, there was no difficulty in freeing the tumor, except for the attachment to the stomach and the intimate connection of the colon which, as described, covered the lower and outer surface of the mass. It was necessary to remove a segment of the stomach to separate the tumor from it, the gastric defect being closed in the usual manner. The colon could not be freed without obvious injury to its walls and blood supply. It was, therefore, divided a short distance beyond the tumor circumference after which an end-to-end anastomosis was made. A drain was placed in the upper abdomen which was closed in the usual manner (Figs. 2 and 3).

The patient had a very stormy convalescence and at times seemed to be in a hopeless state. Yet, with the assistance of numerous cardiac stimulants, several blood transfusions, and meticulous postoperative care on the part of the internes, the patient eventually made a fairly good recovery. During convalescence there was some drainage from the upper part of the wound which was due to colon bacillus infection. Wet dressings frequently applied cleared up the infection within a short time.

Pathological report. The specimen consists of a huge tumor mass, previously located in the gastrocolic omentum to which was attached a portion of the transverse colon. The latter was markedly adherent to the mass which did not communicate with the lumen. However, the muscularis was firmly adherent in places. The colon measured 18 centimeters in length. The tumor mass measured 22 by 10 by 17 centimeters in the greatest dimensions. On section, it was found to be composed of light, yellowish gray tissue, mixed with purple red. The portion of the tumor mass which was attached to the large bowel was grayish white with a central liquefaction, which was also filled with blood stained material.

Microscopical report. Section of the tumor with attached transverse colon revealed an intact mucosa, submucosa, and muscularis. Attached to the serosa and intimately adherent to it was a large tumor mass composed of islands of elongated cells resembling epithelium with slightly irregular nuclei containing a granular chromatin. The cytoplasm was eosinophilic and granular. The cell borders were indistinct. These islands and cords of cells were separated from each other by a pinkish to bluish staining fibrillated and vacuolated substance. In the more dependent portion of the tumor, away from the colon, these cells were transformed into spindle and stellate forms with much intercellular fibrillary stroma. In this portion of the tumor mass only occasional islands of the previously described cells were seen. The capillaries were few, thin-walled, congested, and in places surrounded by small focal hemorrhages (Fig. 4).

Diagnosis. Schwannoblastoma, a tumor derived from the sheath of Schwann, from its cells or nerve fibers. Histologically, there is but slight evidence of malignancy, chiefly in the form of mitotic figures.

SYMPATHICOBLASTOMA (NEUROCYTOMA)

Reid and Andrus define this type of tumor as a highly malignant tumor arising from undifferentiated cells of the primordium of the autonomic and chromaffin system.

It is stated that Kuester in 1905 was the first to recognize these neoplasms as being glial tissue and he, therefore, classified them as nervous structures. Kuester's histological studies revealed that the fine fibers did not stain red with van Gieson's stain but yellow and that the pattern of rosettes resembled those of glioma.

According to Herxheimer, who collected all cases up to 1914, the first case was described by G. Parker.

The nomenclature of these tumors varies according to the histological pattern and to the examiner's interpretation and preference. We, therefore, encounter the following terminology: neurocytoma, sympathicoblastoma (Pick, Bielschowsky, Wright), ganglioma embryonale sympathicum (Pick), sympathicogoniom (Herxheimer). Bailey and Cushing prefer the term sympathicoblastoma, a tumor made up of "wandering cells

Fig. 5. Histological appearance of tumor, low power.

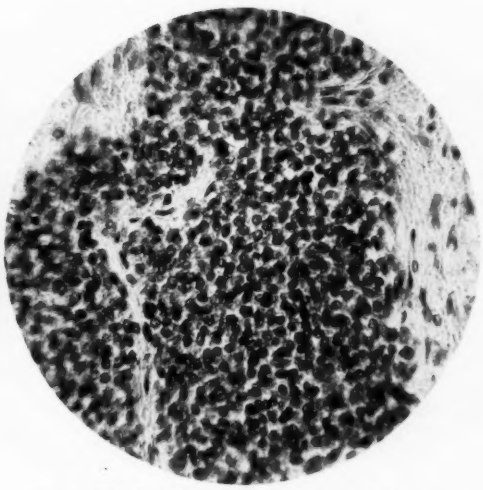


Fig. 6. Histological appearance of tumor, high power.

from the ganglionic crest, which have not differentiated."

Symptomatology. Sympathetic tumors may be silent for a long time and are often discovered quite accidentally in the course of a systematic physical examination. They give rise to clinical symptoms by interference with the function of neighboring organs with which they are in intimate contact. They may compress or infiltrate neighboring veins, as it happened in our case, and may be the first clinical evidence of pelvic or abdominal compression by a tumor mass. Edema of one or both legs of unknown origin, and in the absence of thrombophlebitis, calls for a careful examination of the pelvis.

Diagnosis and differential diagnosis. One has to differentiate these tumors from other intraperitoneal or retroperitoneal tumors. The simple

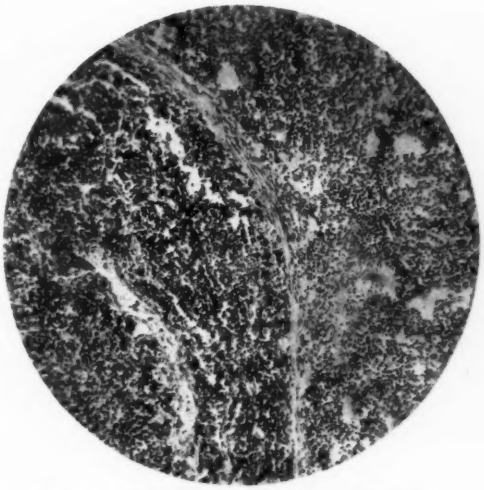


Fig. 7. Lymph node with neoplastic infiltration.

Fig. 8. Histology of tumor embolus in right auricle.

test of inflating the rectum and sigmoid with air will often help in determining whether the tumor is intraperitoneal or retroperitoneal. If the tumor disappears after inflation, and the percussion note, heretofore flat or dull, becomes resonant, the tumor is retroperitoneal. The following tumors have to be differentiated from sympathicoblastoma: hypernephroma, chloroma, osteosarcoma, lymphogranuloma. Kidney tumors may be differentiated by either intravenous or retrograde pyelograms.

Roentgenograms, while not diagnostic as to the nature of the tumor, reveal the presence of a tumor shadow and are especially valuable if the tumor is located in the chest.

Pathology. Sympathicoblastoma is found in newborn, premature, and in very young children. Exceptionally, it may be found in adults, in which case it represents the more mature type of tumor. The case of Barnewitz was a woman, 37 years old. Our case was a woman, 51 years of age. Jaffé's case was a woman, 31 years old. The cases seem to occur more often in women (Landau). The tumor originates either from the adrenal medulla, or less commonly from the sympathetic plexus, sympathetic ganglia, or paraganglia. It may be found in the chest, neck, or abdomen. In the neck it may originate from the cervical ganglion, or it may be metastatic from a suprarenal tumor (Blacklock). Shizuo Tsunoda reported multiple tumors of various sizes in the terminal jejunum which proved to be sympathicoblastomas. John Norcross reported 4 cases "rarely encountered in the practice of orthopedic surgery." One was a girl, 18 months old, who had a tumor within the spinal canal at the level of the ninth thoracic vertebra, extending into the thoracic cavity. The second case, a boy of 9 with a tumor at the costovertebral junction of the third rib, extending into the spinal canal. The third case, a boy of 6, with a tumor in the mediastinum. The fourth case, a girl, 5 years old, with a mass in the abdomen to the left of the spine. All four tumors proved to be sympathicoblastomas. H. H. Schmid, in a collective survey of 267 cases of retroperitoneal and mesenteric tumors, found 10 ganglioneuromas. Stoeckel in a survey of pelvic tumors up to 1923, found only a couple dozen of pelvic tumors of sympathetic origin. The tumor varies from the size of a walnut to that of a child's head. It may compress the tissues in the vicinity. It has a tendency to form thrombi in large vessels, infiltrate, bleed extensively, and metastasize. The histologically mature type seldom metastasizes, whereas the immature type metastasizes in the liver, lymph nodes, orbit, and occasionally the spleen.

From the standpoint of malignancy, the tumor may be classified according to its clinical tendencies or according to the histological pattern. Clinically, two types have been described:

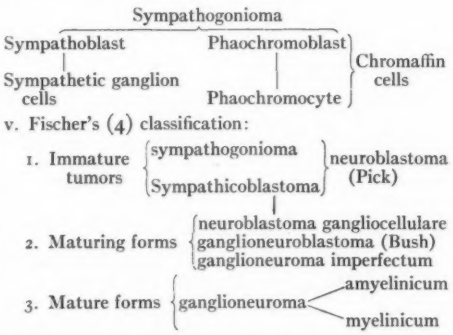
1. Pepper type, giving metastases in lymph nodes and liver. Clinically, the patient has a large and painless abdomen and a large liver.
2. Hutchinson type, giving metastases in bones, especially skull. Clinically, the patients have ecchymoses and exophthalmos.

Histologically, there are several classifications. Karl Rupilius classified sympathicoblastoma as follows:

1. Immature form (sympathetic neuroblastoma, sympathicogonioma, sympathicoblastoma).
2. Maturing form (ganglioneuroblastoma).
3. Mature form (ganglioneuroma).

Sympathicoblastoma, although made up of immature forms, may occasionally show other types and transitional forms from primitive neuroblasts to mature ganglionic cells (Pick, Landau). Wahl reported a case of mixed neurogenic elements.

Poll and Pick's classification:



Because of the presence of small round cells, these tumors have been occasionally designated as small round cell sarcoma. We encountered such terms as lymphosarcoma (De Ruyter) or round cell sarcoma (Heaton, Wilke), or hemorrhagic sarcoma (Bruck).

Histopathology. The average pattern is made up of round cells, a little larger than a lymphocyte, arranged in rosettes with a stroma of finely interlaced fibrillæ, which take a silver stain. Herxheimer, using Bielschowsky's stain, was the first to find axones in stroma. According to Marchand, the cells are arranged either in clumps or in alveolar fashion. The grouping of cells often resemble glands around a lumen. The small cells have hyperchromatic nuclei and little cytoplasm.

Pick, on the basis of histological pattern, distinguishes two types: (a) cellular (b) fibrocellular. In the first instance, the cells arrangement may be either diffuse or alveolar; in the second instance, one finds palisades.

Treatment. I am as unfamiliar with the sensitivity of these tumors to x-rays or radium, as are radiologists and radium therapeutists. Surgeons will usually decide upon removal when the tumor is discovered. In my only experience with such neoplasms, I was stunned by the great tendency of the tumor to extensive hemorrhages at the slightest touch and the utter helplessness of controlling a massive hemorrhage, even though the tumor is well encapsulated and free from neighborhood attachments.

ABSTRACT OF CLINICAL HISTORY

M. G., age 51 years, female, white, was admitted to hospital January 10, 1938, and died January 13, 1938.

The history revealed sudden onset of unilateral edema of the right leg of 6 weeks' duration. She had not noticed any change in temperature, color, pain, or local symptoms other than pitting edema. She was treated locally with slight improvement. One week prior to entrance a mass was found in the abdomen. The patient had not noticed this previously and had had no symptoms referable to the mass. The patient did not suffer from loss of weight, anorexia, or change in bowel habit. There were no gastro-urinary symptoms. She had a gradual decrease in frequency of menses for the past 2 years and at the present time they occurred every 4 to 6 months, with moderate flow. There was no intermenstrual bleeding. The remainder of the history was essentially negative.

Physical examination. The head, neck, heart, and lungs, were negative. There were no adenopathies. The blood pressure was 150/84. The abdomen showed marked diastasis recti through which it was easy to palpate a large, firm, round mass, about the size of a large orange, in the right lower quadrant about the level of the ovary. It was somewhat fixed to deeper structures and not tender to touch. Vaginal and rectal examinations were not done. There was present pitting edema of the right leg to the thigh. There was no tenderness or temperature change. The blood count showed; hemoglobin, 90 per cent; red blood cells, 4,500,000; white blood cells, 7,600; polymorphonuclears, 63—band forms, 1; small lymphocytes, 38; monocytes, 2. The urine was negative.

On January 11, she was sent to x-ray department for a flat plate and barium enema.

On January 13, under general anesthesia a midline incision was made. A large retroperitoneal mass was found in the right lower quadrant. In attempting to remove it, massive hemorrhage was incurred. The patient's blood pressure dropped to systolic of 50 and the pulse was imperceptible. She was given stimulants, saline, gum acacia, and 500 cubic centimeters of whole blood. Three packs were inserted and the patient taken to room and put in oxygen tent. The pulse and blood pressure never picked up. Despite further shock therapy, the patient expired at 10:55 a.m.

Summary of postmortem examination. The clinical diagnosis was retroperitoneal neurocytoma; surgical shock.

Gross anatomical diagnosis—	Histological diagnosis
Right leg: Edema	
Eyes; Conjunctival petechiæ	
Peritoneal cavity: Hemoperitoneum, status after laparotomy —old scar of abdomen	
Heart: Eccentric hypertrophy	
Anemia	
Tumor embolus in right auricle	Sympathicoblastoma
Thrombus in vena cava inferior—	Sympathicoblastoma
Lungs: Partial atelectasis of both lobes (left)	
Acute emphysema (right)	Atelectasis
Anemia	
Spleen: Acute anemia	Acute passive congestion
Liver: Acute anemia	
Kidneys: Hydronephrosis (right)	Acute passive congestion
Ureters: Compression of right ureter by tumor resulting in right hydroureter and hydronephrosis	Sympathicoblastoma
Uterus: Multiple fibroids (intramural and subserous) (one calcified)	
Cervical polyp	
Rectal polyp:	Rectal polyp (benign)
Psoas muscle:	Sympathicoblastoma
Lymph nodes:	Sympathicoblastoma
Cause of death:	
Acute anemia due to hemorrhage.	
Tumor embolus in right auricle.	
Retroperitoneal sympathicoblastoma originating at bifurcation of right common iliac artery, compressing the arteries, invading the veins.	

Autopsy. Microscopic examination of the sections of the lung tissue showed extensive atelectasis. In the liver sections were small accumulations of lymphocytes in the interacinar connective tissue. The yellow nodule in kidney was due to the presence of adrenal cortical tissue. No evidence of malignancy was found in the rectal polyp. A diffuse infiltration with tumor tissue of the same structure as seen in the primary tumor was noted in some of the lymph nodes. The other lymph nodes showed marked hyperplasia of the reticulo-endothelium and foci of calcification.

Sections of the tumor mass specimen show a very cellular growth with extensive hemorrhages. The cells show very scanty cytoplasm and medium size oval shaped nuclei with an abundant amount of chromatin that is finely distributed. Between the cells there are present fine, very indistinctly staining fibrils. The connective tissue stroma between the cell accumulations is not very abundant. The vascularization is very rich. The cells are arranged in very dense layers around the blood vessels. The structure is in every way identical with the structure reported in the retroperitoneal tumor removed at operation on January 13, 1938. The picture is that of a neurocytoma or sympathicoblastoma.

A thrombus was present in vena cava inferior. Sections of the psoas muscle show infiltration of muscle tissue with tumor tissue. An embolus in the heart was of identical structure with the structure of the tumor. Figure 8 illustrates the histology of a tumor embolus.

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THE INJECTION TREATMENT OF HERNIA

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IN the last few years much has been written about the injection treatment of hernia. The glowing reports of complete cures of all types of hernia, even up to 100 per cent, have been very enthusiastic. This enthusiasm, unfortunately, has resulted in a wholesale onslaught on all kinds of hernias with various types of injection solutions. The indiscriminate use of these irritating solutions by those unskilled in the technique is apt to produce serious consequences. Hernias are being injected by hundreds of physicians who would not attempt surgical repair because of their lack of knowledge of the anatomy of the inguinal region and the surgical technique. Yet these same physicians will take chances on introducing a strong irritant into a human body with the hope that it will get into the proper place, and will not cause gangrene and perforation of a loop of bowel, followed by peritonitis and death. These accidents probably have occurred many times, with fatal results, but the literature records very few accidents of this type.

Berne has recently reported 2 deaths following the injection of the solution into the bowel wall with resulting gangrene, perforation, and peritonitis. Neither of these patients was injected by him. He mentions 2 others reported by Fowler. Berne also quotes Harris and White as having averaged 1 intraperitoneal injection in every 20 patients treated. But the literature, in most instances, minimizes the dangers of the injection treatment and leaves the impression that even the intraperitoneal injection of a proliferating solution is not of serious consequence. Berne's article is a timely and valuable contribution. Personal experience with complications in over two thousand injections has been quite meager. However, it might not have been if the very important precaution of always aspirating before injecting had been neglected. One patient had severe pain in the right pelvis a few minutes after an injection on the left side at the internal ring. The pain lasted about 15 minutes and was so severe that she could not lie still, rolling about on the table. Fortunately, she had no further trouble after leaving the clinic. Blood has been aspirated on 3 occasions when the needle was inserted at the neck of the sac. The needle was withdrawn without injecting any solution, and there was no reaction. Edema of the cord is not infrequently seen, but it is not serious. Delayed pain has been complained of by a few who reported inability to work for 2 or 3 days after an injection. One abscess was encountered several days after an injection. It was incised and drained outside the hernia clinic. No culture was taken, and it is therefore unknown whether the content was sterile or infectious.

Berne rightly speaks of the greater danger of entering the peritoneal cavity when the needle is deeply introduced, and yet it appears necessary to make deep injections at the neck of the sac if the hernia is to be permanently obliterated. If the needle, while being introduced deep at the internal ring, suddenly meets with absolutely no resistance at all, and if aspiration reveals nothing, it must be suspected of having entered the peritoneal cavity and should be withdrawn to the point where resistance is encountered. This procedure will prevent injecting the irritant into the peritoneal cavity, and thereby remove the greatest danger connected with the treatment.

Bratrud mentions 2 cases seen in consultation in which the deep epigastric artery had been injected, with slough near the umbilicus. He also reports the case of a patient, treated elsewhere, who died as a result of intraperitoneal injection with perforation of the ileum and peritonitis. One of his own patients who was immediately operated upon because of severe abdominal pain following an injection showed no signs of peritonitis. All patients who experience severe abdominal pain after an injection, however, should be treated as potential peritonitis cases, and kept under observation until their symptoms have disappeared.

McKinney reported 2 strangulations due to the truss, one in a woman after fifteen injections, the other without injection. In consultation he also saw a patient who developed thrombosis or embolism of the anterior tibial artery with loss of a toe on the same side following an injection, and another who developed an abscess as a result of injection of the solution into a blood vessel of the spermatic cord. One of his patients had an abscess following injection for a recurrent hernia after appendectomy. These less serious accidents

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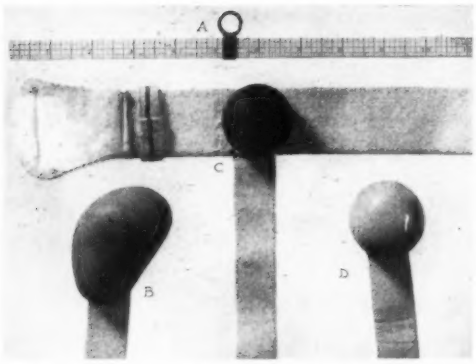


Fig. 1. *A*, Transparent ruler with slide ring.[1] *B*, The pad of the "injection truss" attached to the perineal band, which in turn slides on the abdominal band for adjustment to right or left. This pad covers internal ring and inguinal canal, and does not press on symphysis. *C*, "Test truss,"[2] with moderately thin pad, used in most cases. It is 1.5 inches in diameter. It is shown on the abdominal band of "short stretch" webbing. *D*, "Test truss" with thicker pad, on perineal band, for use in heavier subjects. More pressure can be obtained with this pad when testing the hernia.

caused confinement of the patients in the hospital from a few days to a few weeks. Another patient with symptoms of local peritonitis following injection for recurrent hernia was operated upon, and a small area of local peritonitis was found.

Rice reported 12 instances in a series of 445 cured cases, of peritoneal irritation, and 66 minor complications including 2 local abscesses. It is therefore obvious that the injection treatment of hernia is not devoid of serious and even dangerous complications and sequelæ in the hands of skilled operators. As Bratrud says, "There is a definite technique and unless this is learned great harm may result. This cannot be too strongly emphasized."

Although the literature has apparently been quite extensive and comprehensive it still appears advisable further to emphasize the fact that the injection treatment of hernia is not as simple as giving an ordinary hypodermic injection. It would appear that the rules for the proper selection of cases have not been stated definitely enough for the guidance of those only occasionally using the method. The indications for the injection treatment of hernia should be more specific and, as explained below, should be fewer. Hernias which do not fulfill certain requirements should not be injected. McKinney advises that "the small hernia in the young individual offers the ideal case for treatment by this method." Bratrud appears to be too inclusive when he makes the statement that "umbilical, indirect inguinal, direct inguinal, and recurrent herniæ give the best results," and in stating further that "laying aside the contra-indications, it may be said that any inguinal hernia can be treated provided that it is reducible and can be held reduced by a properly fitting truss, and provided that there are no surgical contra-indications." Wangensteen remarks that "the selection of appropriate cases is extremely important. The small reducible, indirect hernia in the young person with strong tissues seems most suitable for this method of treatment. An anxiety to extend the method to cases that present large defects and poor tissues results in a large incidence of failures." However, it still seems advisable to limit the indications for the selection of cases even more definitely. When a hernia is a "selected" one it should be one which is shown by experience to respond consistently to treatment. In the author's opinion the injection treatment of hernia should be limited to the small indirect inguinal hernia which fulfills the indications to be described later. Other types of hernia may, and occasionally do, yield to treatment. The indirect inguinal hernia should have a greater prospect of cure because of the length and anatomical characteristics of the canal. If the canal can be obliterated the hernia can be cured. In most other hernias the success of treatment depends on filling in or covering over the weak place in the abdominal wall with a layer of scar tissue. Scar tissue is weak tissue and will become weaker as time progresses, particularly as atrophy takes place. A defect cannot be filled or covered with scar tissue strong enough to prevent herniation. This is also the opinion of Crohn, and of Burdick and Coley.

THE "SELECTED CASE"

The selection of a hernia for injection treatment at the hernia clinic at the University of Illinois depends very definitely on the fulfillment of the following positive indications:

1. Must be indirect inguinal.
2. Must be completely reducible.
3. Must be held reduced by "test truss" (see *C* and *D* Fig. 1).
4. The external ring must be no larger than a nickel (2 centimeters in diameter).
5. The external oblique aponeurosis at the external ring must not be thinned out or shredded.
6. The inguinal canal must be at least 1 inch in length.

[1]Made by V. Mueller & Co., Chicago.
[2]Made by Brooks Appliance Co., Chicago.

Fig. 2. The anterior superior spine of the ileum and the spine of the pubis are marked with tincture of iodine. The slide ring is set on the transparent ruler half way between the two marks and iodine is applied within the circle. This locates the internal ring. This young man has no hernia on the side being marked, but was picked at random to demonstrate the method of locating the internal ring.

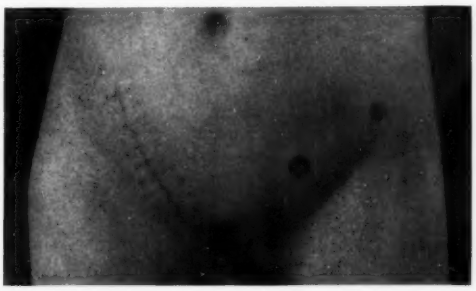


Fig. 3. The skin over the internal ring is marked with tincture of iodine and ready for injection.

7. The patient must be in otherwise good health and of at least average co-operative mentality.

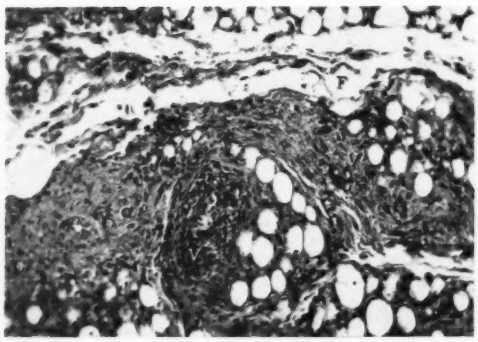
If these indications are observed there is no need of listing contra-indications, which have been voluminous. An epileptic might escape indication 7 unless a careful history is taken; obviously if the patient should have a convulsion during the injection a serious accident might be sustained. It is our opinion that only those hernias which fulfill the indications mentioned should be given the injection treatment. All others should be treated surgically or with a truss alone.

EQUIPMENT NEEDED

The syringe may be either the tuberculin or ordinary Luer type. The needle should be 22 gauge, an inch and a half in length, and with a bevel decidedly shorter than the standard short bevel. This allows more delicate feel in going through the various layers of fascia and muscle. The solution used in our clinic is the phenol-alcohol-thuja mixture. A transparent ruler with a sliding ring (*A*, Fig. 1) has been of great convenience in determining the location of the internal ring. A "test truss" (*C* and *D*, Fig. 1.) is used in selecting each new case which has already fulfilled the other positive indications and thought to be suitable for the treatment. It consists of a firm pad an inch and a half in diameter, built on short stretch webbing, and can be adjusted to either right or left side. It is made with either of two pads (*C* and *D* as shown in the illustration), the thicker one being used in the heavier subjects. After the internal ring is marked with the aid of the slide ring and ruler the "test truss" pad is adjusted over it, the belt is tightened, and the perineal band is fastened. Then the patient tries to make the hernia descend by bearing down, coughing, and stooping. This test determines whether or not the case fulfills indication 3. The "injection truss," which is worn day and night by a patient receiving injections, is composed of two parts—an abdominal band of "short stretch" webbing and a perineal band of softer webbing which embraces the pad. The pad is attached in the front of a loop at one end of the perineal band. This loop slides on the abdominal band to allow adjustment of the pad to right or left, and is anchored to the abdominal band with needle and thread when the pad is properly placed over the internal ring. The type of pad on the "injection truss" is shown (*B*, Fig. 1) in the illustration, attached to the perineal band. The abdominal band is an inch and a half wide. It is made of "short stretch" webbing which is so constructed that it will stretch only one inch to each foot of webbing. This is just enough to allow body freedom without allowing the pad to shift in position or relax in pressure. This truss has been found to be most satisfactory for those receiving the injection treatment because it stays in place at all times and in all positions, even when the patient lies on his back. No patient has yet complained that this truss, when properly fitted, has been uncomfortable. The "injection truss" is worn continuously for a week before injections are started, and must have held the hernia completely during all that time.

TECHNIQUE

The patient, lying flat on his back, removes his truss without straining. He is taught how to do this so that he may remove the truss for sponge baths to keep the skin and pad clean. The inguinal region is examined to make sure that the



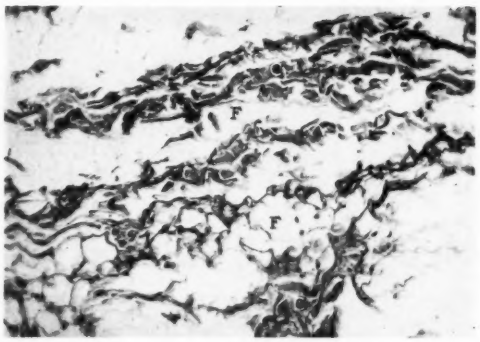


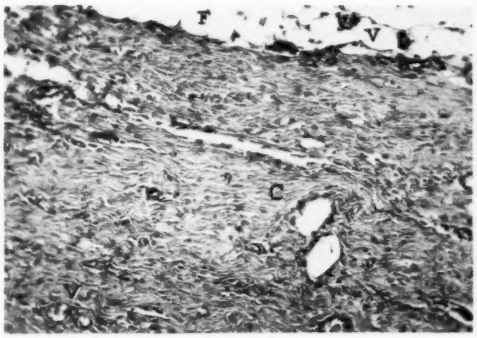
Fig. 4. Left, 2 weeks following injection of Solution V, as noted, there is a deposition of dense scar tissue. The fatty subcutaneous tissue, *f*, is shown being replaced by fibrous connective tissue, *c*, which is being formed from the proliferation of round cells, histiocytes, and fibroblasts arising about the numerous vascular centers, *v,v*. Right, 8 weeks following injection of Solution V. The scar tissue is now hyaline in character, relatively acellular, and broken up into thin strands. Fatty infiltration, *f*, is producing resorption of the scar.

hernia is being held by the truss. This is done before every injection as a precaution against injecting into a loop of bowel or other possible content of a hernial sac, and cannot be too strongly emphasized. The first injection is given deep at the internal ring. To make as accurate as possible the location of the internal ring is the function of the transparent ruler with slide ring, said ring being 1 centimeter above the edge of the ruler. The anterior iliac spine and the spine of the pubis are spotted with tincture of iodine. The distance between them is measured with the ruler, the slide ring adjusted half way between, and iodine is applied within the ring. This definitely marks the location of the internal ring (Figs. 2 and 3 illustrate the technique). The site of injection is prepared further with tincture of iodine; the syringe is loaded with the proper amount (8 minims) of solution plus a small amount of air for cleaning the needle at the end of the injection.

With the syringe held vertically the needle is inserted perpendicularly through the skin. The point then rests on the aponeurosis of the external oblique, which offers firm resistance. The introduction of the needle through the aponeurosis requires enough pressure so that a distinct lack of resistance is felt as soon as the tip of the needle has penetrated it. The internal oblique and transversalis muscles must now be penetrated before the internal ring is reached. Here the sensation is less pronounced than when the needle passed through the aponeurosis, and concentration is required to determine exactly the point at which these muscles have been penetrated and the transversalis fascia reached. It is at this location that the solution is to be deposited. But first—aspirate! There should be at least slight resistance to the needle tip if the deep epigastric artery or peritoneal cavity have not been entered. The depth of the needle point at the neck of the sac is usually between an inch and an inch and a quarter. In very heavy subjects it is more. A minute amount of solution is injected slowly. If some of it enters the sac it may seep into the peritoneal cavity. This would cause severe pain, in which case the needle should be withdrawn without injection of more solution. If there is no severe reaction after a few seconds, the remainder of the solution is injected and the air in the syringe is forced through to clean the needle. This reduces the likelihood of dragging the irritant through the tissues when the needle is withdrawn and eliminates the formation of subcutaneous nodules. Theoretically a minute amount of the solution injected into the empty sac near its neck would produce sclerosis at the most desirable site, but injecting the entire contents of the syringe at this point might cause intraperitoneal complications. If the patient should complain of abdominal pain during the first part of the injection no more of the solution should be injected at that time. Firm pressure with an alcohol sponge is maintained over the site of injection for about 30 seconds after removal of the needle. The patient replaces his truss without straining.

FREQUENCY AND NUMBER OF INJECTIONS

An injection is given once a week for 10 weeks. The first 6 are given deep at the internal ring. The last 4 are given along the inguinal canal just beneath the aponeurosis of the external oblique, beginning over the internal ring, proceeding down-



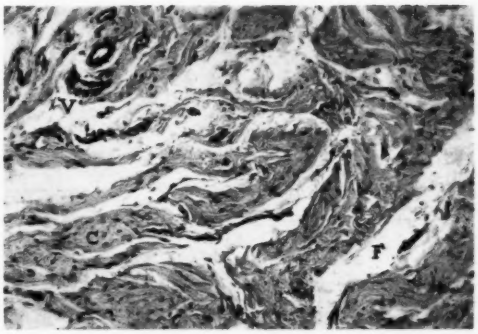


Fig. 5. At left, 2 weeks following injection of Solution II. This solution has produced a dense scar of fibrous connective tissue, *c*. Reactive vascular centers, *v*,*v*, are seen throughout the scar already formed, with others in the surrounding subcutaneous fat, *f*. At right, 4 months after injection of Solution II (thuja mixture). This scar tissue has persisted 4 months and is therefore twice as old as that described in Figure 4, right. The fibrous connective tissue, *c*, shows beginning resorption with fat infiltration, *f*. However, the connective tissue strands show considerably more viability and cellularity than those seen in Figure 4, right. There is also evidence of continued reaction about the vascular centers, *v*, indicating that perhaps more scar will be formed. Histologically one may conclude Solution II produces more lasting scar than Solution V. Since duration of scar is of prime importance, Solution II should be considered the best of those solutions which were tested in this experiment.

ward, and ending with the tenth dose one-half inch above the external ring. The external ring is usually obliterated by this time and is rarely treated. Ten injections are sufficient for most cases. Some require 2 or 3 more. But when 20 to 40 are necessary it would seem that the case had not been well selected and that operation should have been done.

POST-INJECTION MANAGEMENT

One month after his last injection the patient returns for examination. If all is well he removes his truss at night for the next month, wearing it only during the day. If it is still holding satisfactorily at the end of this second month he is allowed to remove the truss entirely. He is advised against only one thing—heavy lifting. Otherwise he may pursue his regular and customary habits. At the end of the next month, if there is no sign of hernia, he is allowed to go 2 months before being examined. He is examined at intervals of 2 months until he has remained free from recurrence for one year after the truss has been discarded. Then he is considered cured.

RECURRENCE AND SCAR ABSORPTION

Every hernia carefully selected for the injection treatment is apparently cured at the time of the second month checkup following the last injection. At this time the truss is discarded both day and night. Four to 6 months later, a small percentage of these cases show a weakening at the site of the hernia, or even an actual recurrence. It has been noted that those cases which survived this period of potential recurrence remained cured. This suggests that absorption of the scar tissue is the probable cause of recurrence. Animal experiments confirm this suspicion. Recurrent cases were given a complete new course of 10 treatments, usually with satisfactory results. Those with merely a weakness in the inguinal region were given 2 to 4 additional injections.

ANIMAL EXPERIMENTS

Six different solutions were used in the experiment. The dogs were injected at 6 different places on the back and at one point in the rectus muscle with each solution. No attempt was made to determine the immediate effects of the various solutions because this has been done by other investigators with conclusive evidence of their scar-producing effects. Proof is not lacking that mature scar tissue is formed within 4 to 6 weeks after the solution has been injected. But most workers have seemed to be satisfied with the knowledge that good scar tissue was formed within a given time without continuing the experiment far enough to determine how long the scar would last.

Biopsies were made at periods of 2, 4, 6, and 8 weeks, and then at 3 and 4 months. The results are shown in the summary of experimental work (Table I), and in the photomicrographs (Figs. 4 and 5). In the first biopsies (2 weeks after injection treatment), Solution V had produced the best early scar tissue, but absorption began as

TABLE I.—SUMMARY OF EXPERIMENTAL WORK

Solution No.	Hemorrhage	Necrosis	Monocytes and histiocytes	Time of scar appearance	Absorption of scar, or restitution	Duration of scar	Remarks
I	±	±	2 wks.	4 wks.	3–4 mos.	3–4 mos.	Traces of material left at end of 4 mos., but scar practically gone
II	±	±	2 wks.	2–4 wks.	Slowly at 4 mos.	4 mos.	Early scar. Material present with less scar at 4 mos. Muscle giant cells and edema at 12 wks.
III	Plus 2	Plus 2	2–4 wks. Polymorphs.	Beginning to form 2 wks.	.....	.....	Discontinued
IV	Plus 3	Plus 1 through 4 wks.	2 wks. Polymorphs. present Plus 2.	4 wks.	3–4 mos.	3–4 mos.	Good scar at 12 wks., but almost gone at 4 mos.
V	Plus 1	±	2 wks.	2 wks.	6–8 wks.	6–8 wks.	Dense scar early, but after 6 to 8 wks. though globules of injection solution present, the scar is disappearing rapidly
VI	Plus 1 4 wks.	Plus 2 4 wks.	2–4 wks. Pus cells Plus 3.	2–4 wks. Poor	Complete in 6–8 wks.	4–6 wks.	Moderately severe delayed reaction with poor scar formation in spite of prolonged inflammatory reaction

early as the third biopsy at 6 weeks. It will be seen that the scar tissue produced by Solution II —the phenol-alcohol-thuja solution—was the most enduring, but that even that scar tissue was beginning to disappear after 3 and 4 months in spite of the fact that the material was still seen in the tissues in microscopical sections.

This absorption of scar tissue after 4 months seems to offer sufficient evidence to explain clinical failures which show up between 4 and 6 months.

SUMMARY AND CONCLUSIONS

The injection method of treating hernia is with us, probably to stay. That it has merit in certain cases cannot be denied. Hundreds, if not thousands, of physicians have adopted it. Many cures have been effected. It cannot supplant surgery as a better method in the majority of instances, but it has its place, which is in the treatment of small indirect inguinal hernias. Other hernias should be repaired surgically. In 2 series of cases carefully "selected," as previously described, surgical repair would undoubtedly have a much lower incidence of recurrence than the injection method. This experiment would furnish a basis for comparison, if in such a study one would pick out comparable cases from the series of patients treated by operation and by injection.

This method of treatment is not as simple and foolproof as the medical and pharmaceutical literature would lead one to believe. It is not without danger of serious complications even in experienced hands.

The ideal injection solution has not yet been developed. If the same dense progressive scar tissue could be produced in the inguinal region that is produced in the lungs of silicosis cases the success of the injection treatment of "selected" hernias could probably be assured. An attempt to produce such a solution is now being made with various silica preparations.

The primary purpose of this report is to emphasize the necessity of following a strict technique and carefully selecting the hernias for treatment, injecting only those hernias which have a reasonable expectancy for cure, lest the bad results following poor selection and ill advised injection treatment lead the method into disrepute.

The author is indebted to Mr. L. J. Rossiter for his assistance in the preparation and interpretation of the microscopical slides.

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OPERATIVE TREATMENT OF PES PLANUS

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IN this paper the view will be held with others that the foot has but one arch which is a segment of a dome. Pes planus will be considered a severe pathological depression of this arch with eversion of the foot, abduction of the forefoot, and contracture of the muscles of the tendocalcaneus. Well known flatfoot operations, which have previously been described, are of three general types. They are first, arthrodesis of one or more of the intertarsal joints; second, tendon operations to modify the muscular forces which act on the foot; and third, wedge osteotomies of the tarsal bones. There may be a combination of these operations in one operative procedure.

Among the first type of operations, arthrodesis of the talonavicular joint by excision of the articular cartilage is the simplest. This procedure has a low degree of efficiency so that Soule modified it by inserting a bone peg through the navicular bone into the head of the talus. Hoke mortises a section of the cortex of the tibia between the adjoining surfaces of the navicular and first cuneiform bones after lengthening the tendocalcaneus. The arthrodesis includes the joint between the navicular and the second cuneiform bones. Miller performs an arthrodesis of the navicular-cuneiform and the first tarsometatarsal joints. In this operation he also transplants and shortens the tendon of the tibialis posterior muscle.

As an example of the tendon operations, plastic lengthening of the tendocalcaneus to relieve the contracture of its muscles as a deforming factor, is performed as part of nearly all flatfoot operations. However, lengthening of the tendocalcaneus and follow up exercises are not sufficient to expect improvement of the arch to any great extent.

Lowman combined arthrodesis of the talonavicular joint with redirection of the tibialis anterior tendon posterior to the navicular bone in the space between the latter and the talus. In this operation the insertion of the tibialis anterior was not detached. Later he modified the procedure by re-enforcing the ligaments on the medial side of the tarsus with a transplant from the tendocalcaneus or the plantaris tendon. Lord modified the Gleich (2) osteotomy of the calcaneus to overcome eversion and added various supplementary procedures as indicated. Clark performs wedge osteotomies of the talus in two planes with base medial; a vertical one through the neck of the bone and the other to include the inferior surface.

The writer has endeavored to work out a simple technique which would raise the arch of the foot and balance the superimposed weight on its bones by postural tonus rather than by an arthrodesing operation or by wedge osteotomies.

TECHNIQUE OF OPERATION

A plastic lengthening of the tendocalcaneus is performed as a preliminary procedure so that the anterior end of the calcaneus can be elevated when the arch is raised. In the operation on the foot itself a slightly curved incision with convexity upward is made on its medial aspect from the shaft of the first metatarsal bone to the inferior extremity of the medial malleolus. The incision should pass superior to the medial aspect of the navicular bone. After the skin and superficial fascia are reflected, the larger branches of the medial tarsal artery in the region of the superior aspect of the navicular bone should be exposed under the deep fascia and ligated. The tendon of the tibialis posterior muscle is temporarily separated with a periosteal elevator from its attachment to the inferior surface of the navicular tuberosity. The medial one-half of the inferior surfaces of the navicular and first cuneiform bones are exposed in this dissection. A drill hole 6 or 7 millimeters in diameter is made vertically through the navicular bone lateral to the tuberosity from the superior to the inferior surface. The superior opening of the drill hole is made oval in shape with a gouge. A slot 2 millimeters wide is made with a gigli saw and very thin chisel from the drill hole to the posterior part of the medial surface of the navicular tuberosity. A small gouge is used to make a groove on the inferior surfaces of the first cuneiform and the navicular bones from the insertion of the tibialis anterior muscle to the drill hole at its inferior end. The sheath of the tibialis anterior tendon is exposed and incised in its distal 6 or 8 centimeters. After the tendon is freed down to its insertion, it is pulled posterior with a button hook and thrust through the slot in the navicular bone to a position in the drill hole and in the groove on the inferior surfaces of the navicular and first

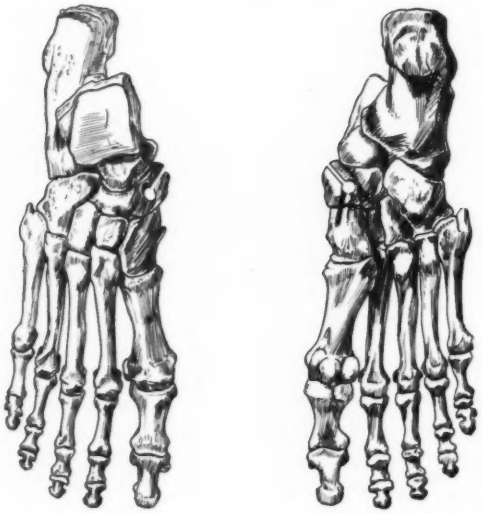

Fig. 1. A, Skeleton of the right foot from the superior aspect, showing position of drill hole and slot in the navicular bone. B, Plantar view illustrating drill hole and slot from this aspect. Attention is called to the shaded area which indicates the groove on the inferior surfaces of the navicular and first cuneiform bones.

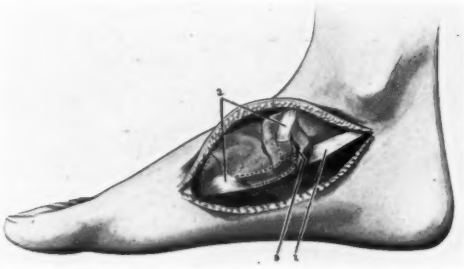

Fig. 2. The tendon of the tibialis anterior muscle is looped through a drill hole in the navicular bone. *1*, Tendon of tibialis posterior; *2*, tendon of tibialis anterior; *3*, slot from drill hole to posterior part of medial aspect of navicular bone.

cuneiform bones. Two pronged instruments in the shape of the letter U on the end of a rod are useful to force the tendon through the slot. The small chips of bone taken from the slot are replaced. No retentive sutures are necessary because the tendon is firmly fixed in its new position. The tendon of the tibialis posterior is replaced as near as possible to its original position.

Following the operation, the extremity is immobilized with a plaster cast from the toes to the upper part of the thigh. The ankle is fixed in its limit of dorsiflexion and the knee in 20 degrees

Fig. 3. Case 3. Pre-operative roentgenogram of right foot.

Fig. 4. Case 3. Seven months after operation.

Fig. 5. Case 5. Pre-operative lateral view of right foot.

Fig. 6. Case 5. Four months after operation.

of flexion. The sutures are removed through a window in the cast 2 weeks after operation. The cast is removed 7 or 8 weeks after the operation to allow firm healing of the tendocalcaneus. Obviously the operation on the foot itself would require immobilization only a short time after the incision has healed. It is important for the patient to be taught correct foot posture and gait. When walking is started the lateral side of the heel of the shoe should be lowered one-eighth to one-fourth inch, to prevent eversion strain for 6 months. Resistive exercises should be practiced daily in this interval to develop the tibialis anterior and tibialis posterior muscles.

This operation has been performed on six adolescent patients and one adult with satisfactory raising of the arch and correction of the eversion and abduction of the forefoot in each case. There has also been symptomatic relief in all cases. Originally it was thought that the procedure would be useful only in adolescents. Therefore in the pes planus of the adult the operation was performed on the right foot only with a heel cord lengthening on the left leg. The result of the flatfoot operation has been so satisfactory that operation on the left foot will be done.

One patient aged 11 years was a mulatto. As a school boy he complained of aching in his feet while standing and walking, and therefore sat on a bench while other boys played. Conservative treatment did not seem to offer much improvement in such a severe case and therefore the operation was performed, although criticism was expected for surgical treatment of a flatfoot in one of the colored race. However, the result was sufficiently good to justify the operation.

In this group of cases there were no wound infections. However, a hematoma developed in one case and the cause was traced to an injury of the branches of the medial tarsal artery during the exposure of the navicular bone. This is the reason for ligating the artery during the exposure. The first patient had more postoperative pain than the others because the sheath of the tibialis anterior tendon was not incised far enough in a proximal direction to free the tendon. This caused painful tension on the soft parts to which the tendon sheath was attached.

EFFECT OF OPERATION

This operation raises the arch of the foot by adding the power of the tibialis anterior muscle to that of the tibialis posterior near the point of primary insertion of the latter on the navicular bone. The tension on the tendon of the tibialis anterior from the position of its insertion, to the inferior opening of the drill hole in the navicular bone, makes it act as a ligament in that part of its changed course. It re-enforces the first medial tarsometatarsal ligament and the plantar navicular cuneiform ligament and in that way helps prevent depression of the arch and abduction of the forefoot. The physiological effect of the operation is to so balance the muscle power of the foot that the weight of the body is sustained by the bones of the arch. Postural tonus of the muscles is all that is required to maintain this balance.

This operation should not be applied until after the age of 10 years because prior to that age ossification has not progressed sufficiently in the tarsal navicular bone. If performed before the navicular bone is ossified it is necessary to use a mattress suture of heavy chromic catgut to bind the two surfaces of the slot in the bone together.

When there is a contracture or spasm of the peroneal muscles, it will be necessary to perform a tenotomy or lengthen their tendons. It is obvious that this operation does not apply in most cases of rigid pes planus in which there are arthritic changes in the intertarsal joints.

CONCLUSIONS

1. Pes planus, not responding to conservative treatment, requires operative correction.

2. The arch may be raised by lengthening the tendocalcaneus and by changing the course of the tendon of the tibialis anterior muscle through a drill hole in the navicular bone to assist the tibialis posterior muscle.

3. The plantar navicular cuneiform and medial first tarsometatarsal ligaments are re-enforced by this procedure.

4. This operation changes the muscular forces which act on the foot, so that the superimposed weight is balanced on the bones of the arch by postural tonus.

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JUNE, 1939

TREATMENT OF DEEP INFECTIONS OF SUBMAXILLARY TRIANGLE

INFECTIONS of the cellular tissues of the floor of the mouth deep to the submaxillary salivary gland, incorrectly called Ludwig's angina, present a grave surgical condition in which energetic and radical treatment is essential. These patients as a rule are extremely ill. They are suffering not only from a profound toxemia of a virulent spreading cellulitis, but also from the disastrous mechanical effects of an edematous submaxillary salivary gland pressing against the lateral pharyngeal wall and indirectly against the larynx. The diagnosis presents no difficulties. The skin over the submaxillary region, while edematous and brawny, is rarely reddened. The swelling is stony hard and fluctuation is seldom obtained because the submaxillary salivary gland with its closely adherent superficial leaflet of the deep cervical fascia presents a dense, unyielding barrier to the deep suppuration which is present. The mouth is partially opened with great difficulty. Forced movement of the protruded tongue, which is elevated and partially fixed, is painful. Examination of the mucous membrane of the floor of the mouth reveals that it is brawny, indurated, edematous, and tender.

There is no doubt that a number of these deep infections which are mild in character subside spontaneously under conservative treatment, but if the clinical condition of the patient is not improved within 24 hours, immediate surgery is indicated.

If the published mortality of 40 per cent in this type of case is to be definitely lowered, either the local buccal incisions, or the median one extending from the under surface of the chin to the hyoid bone must be discontinued. These incisions neither insure immediate and free drainage of the infected area nor stop the progress of the infection. This can be accomplished only by the extirpation of the submaxillary salivary gland under local anesthesia.

This gland automatically blocks the free drainage of the cellular tissues of the sublingual, the submaxillary, and the retromandibular spaces. Following its removal, with the division of the mylohyoid muscle at right angle to its fibers, the resultant cavity is loosely packed. After operation the change is dramatic. There is immediate, definite improvement which is progressive. The patient feels distinctly better, swallowing becomes easier, and dyspnea invariably disappears. The floor of the mouth soon loses its inflamed appearance.

Removal of the submaxillary salivary gland in infections of the floor of the mouth has been used routinely since 1922 and has been found

universally successful in many cases. Even in those rarer unfortunate cases in which the infection has been bilateral, an uneventful clinical course followed the removal of both submaxillary salivary glands. RALPH COLP.

DISRUPTION OF WOUNDS AND POSTOPERATIVE HERNIA ARE PREVENTABLE

ONE of the requisites for a good surgeon is still sound anatomical knowledge. I may be wrong in my opinion that three is a growing tendency to drift away from the old school idea of the necessity for a profound anatomical training as a stepping stone to good surgery. Twenty years ago an article entitled "Anatomical Approach to the Long Bones" was published in one of our leading surgical journals. Though an apparently uninteresting subject it immediately attracted wide attention. It said that "the average general surgeon knows the anatomy of the abdomen but so rarely operates upon the extremities that he has forgotten the anatomy of these regions." This was near the truth, but I question the statement to the effect that surgeons know the anatomy of the abdominal wall; or possibly they know the anatomy but at least they do not respect it if one can judge from the complications and sequelæ of abdominal operations which can be traced to unanatomical abdominal incisions.

One is impressed by the modern surgeon's knowledge of the anatomy and function of the abdominal viscera and the skillful and extensive operations performed upon them, at the same time one is amazed at the complete disregard of the abdominal wall in making an approaching incision. The success of the skillfully done operation is often marred by disruption of the wound or a postoperative hernia. In an effort to eliminate these complications there has been expended by the profession no lack of effort and discussion directed to the repair of the abdominal wound irrespective of structures damaged, with the result that suture material has been condemned and a different technique in closure proposed.

From a study of the records of 9,000 consecutive abdominal incisions for disruption and hernia[1] it is quite evident that those incisions planned upon anatomical lines can be depended upon and should be preferred. It is general knowledge that the wounds which cause so much dissatisfaction are the vertical upper abdominal incisions, and still they continue to be made and continue to result in hernias and disruptions. The hernias result in disability and repeated operations and the disruptions have a mortality of 35 per cent. The surgeon who would be horrified by seeing the quadricep muscle or the Achilles tendon cut across their fibers does not hesitate to cut the posterior sheath of the rectus muscle across its fibers without realizing that this structure is the tendinous continuation of the internal oblique and transversus muscle. The suturing of tendons elsewhere may result in end-to-end union if their corresponding muscles are put at rest in a relaxed position. But since the lateral abdominal muscles are respiratory muscles they cannot be put at rest, and if vomiting or coughing occur tremendous strain is thrown upon the sutured tendons which must give way in spite of any suture technique which may be used. Due to the action of these muscles the tension upon the upper abdominal wall is in a transverse direction. If the posterior sheath is split transversely in the direction of its fibers, even across the linea alba, the wall is not weakened. If the rectus muscle is retracted and preserved, as in the Sloan incision, the structures do not tend to separate, and disruptions and postoperative

[1] J. Am. M. Ass., 1939, 112: 122.

hernia do not occur. The fact that during a period of 10 years preservation of the posterior rectus sheath has resulted in no defective wounds as compared to an experience of 5 per cent disruptions and 6 per cent abdominal hernias when the usual upper abdominal vertical incision in which the posterior sheath was cut across its fibers, gives us the authority to condemn the unanatomical vertical incision. As previously stated, "Disruption of wounds and postoperative hernia in the upper abdomen with the distressing consequences, can be almost, if not completely, eliminated by the use of carefully made anatomical incisions. As a rule, busy surgeons are impatient to reach the diseased organ and resent the extra time and attention necessary to make anatomical incisions, but the ease of closure, the feeling of security in regard to the wound and the added comfort of the patient more than compensates for the extra effort."

ALBERT O. SINGLETON.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE *Compleat Pediatrician*[1] by Davison is a second and completely rewritten edition of a book which appeared first in 1934 and which was received with enthusiasm by pediatricians and men in general practice throughout the country. The author has made use of a unique method of presenting the subject. In his preface he states that the book was compiled with its emphasis on symptoms and signs as clues rather than on description, in the hope that it would be of value from a practical point of view.

The book is divided into 13 chapters. Symptoms and diseases are discussed in the first 7 chapters divided on the basis of the anatomical system chiefly involved and arranged in the order of their frequency. The first chapter, for example, is devoted to the "Respiratory Group" because in pediatric practice the largest incidence of disease is in this group.

These 7 chapters are followed by a very complete chapter on "Laboratory and Other Procedures Frequently Used in Pediatrics," a chapter on "Nutritional Requirements, Feeding and Diets," and chapters on "General, Fluid, Oxygen and Physical Therapy, and Pediatric Nursing," "Growth, Development and General Care of Children," "Physical Examination," and "Drugs and Prescriptions." In the front of the book immediately following the preface the author gives instructions for the proper use of the book. These instructions are necessary because use of the text would be difficult without knowledge of the meaning of all the reference numbers so freely used.

The book is designed to be a quick reference book for the practitioner, the student, and the teacher of pediatrics, and one that can be carried easily and be available when needed for purposes of diagnosis, therapy, and general information. It is a book that fills a very definite need in pediatrics and the present edition is a great improvement over the first.

A. H. PARMELEE.

IN a compendium of 95 pages entitled *Maternal Care Complications*,[2] the American Committee on Maternal Welfare, Inc., has presented the essential facts relative to the 3 major causes of maternal mortality, viz.: toxemias of pregnancy, obstetric hemorrhages, and puerperal infection. The importance of prenatal care, the early recognition of toxic symptoms, and the institution of proper therapy are stressed under the toxemias. Under hemorrhages, the causes, early and late, are outlined and the type of treatment indicated in each condition is suggested. The prophylactic phase in the treatment of puerperal infection is naturally stressed.

There is little in this manual that cannot be found in any standard textbook of obstetrics; however, its brief, simple method of presenting these subjects will make it valuable as a quick ready reference for the practitioner when he is confronted with the problem of managing any of the above mentioned complications. The widespread distribution of this book would be of great value to the practitioner.

CHESTER C. DOHERTY.

HELLNER'S recent monograph, *Die Knochengeschwuelste*,[1] is the fruit of a ten year study of the bone tumors at the Surgical Clinic in Muenster. In 200 pages he discusses the tumors that involve the skeletal system under 4 general divisions. Approximately one-half the book is devoted to benign and malignant tumors of osseous origin. Then benign and malignant tumors of non-osseous origin that arise in close association with bones, such as those arising from the vascular system and marrow elements, are taken into consideration. The third major division is devoted to those tumors that derive their origin from the soft parts, mucous membranes, and fistulas and secondarily invade the bones. The so called periosteal fibrosarcoma is placed in that category. The last section is allocated to the various metastatic tumors of bone. The subject matter is presented from the clinical, roentgenological, and pathological points of view.

Hellner makes a plea for the standardization of the nomenclature of bone tumors. The author emphasizes the fact that diagnosis of bone tumors rests upon the correlation of the clinical observations, the roentgenological studies, and the pathological examination of the tissues. Tribute is paid to the Registry of Bone Sarcoma of the American College of Surgeons for its important contributions. The photographs, photographic reproductions of x-ray films, and photomicrographs with which the text is extensively illustrated are excellent. A comprehensive bibliography is appended. The book can be recommended as a concise review of the present knowledge of bone tumors.

FRANK E. STINCHFIELD.

[1] THE COMPLEAT PEDIATRICIAN; PRACTICAL, DIAGNOSTIC, THERAPEUTIC, AND PREVENTIVE PEDIATRICS. FOR THE USE OF MEDICAL STUDENTS, INTERNES, GENERAL PRACTITIONERS, AND PEDIATRICIANS. By Wilbur C. Davison, M.A., D.Sc., M.D. 2d rev. ed. Durham, N. C.: Duke University Press, 1938.

[2] MATERNAL CARE COMPLICATIONS; THE PRINCIPLES OF MANAGEMENT OF SOME SERIOUS COMPLICATIONS ARISING DURING THE ANTEPARTUM, INTRAPARTUM, AND POSTPARTUM PERIODS. Approved by The American Committee on Maternal Welfare, Inc. Prepared by R. D. Mussey, M.D., P. F. Williams, M.D., and F. H. Falls, M.D. F. L. Adair, M.D., Editor. Chicago, Ill.: The University of Chicago Press, 1938.

[1] DIE KNOCHENGESCHWUELSTE. By Dr. med. habil. Hans Hellner. Berlin: Julius Springer, 1938.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

END-RESULTS IN THE TREATMENT OF GASTRIC CANCER; AN ANALYTICAL STUDY AND STATISTICAL SURVEY OF SIXTY YEARS OF SURGICAL TREATMENT. By Edward M. Livingston, B.Sc., M.D., and George T. Pack, B.Sc., M.D., F.A.C.S. With a foreword by Bowman C. Crowell, M.D. New York and London: Paul B. Hoeber, Inc., 1939.

A TREATISE ON THE SURGICAL TECHNIQUE OF OTO-RHINOLARYNGOLOGY. By Georges Portmann. Collaborators: H. Retrouvey, J. Despons, P. Leduc, and G. Martinaud. Translation by Pierre Viole, M.D. Baltimore: William Wood & Co., 1939.

ANGINA PECTORIS; NERVE PATHWAYS, PHYSIOLOGY, SYMPTOMATOLOGY, AND TREATMENT. By Heyman R. Miller, M.D. Baltimore: The Williams & Wilkins Co., 1939.

THE CLINICAL DIAGNOSIS OF SWELLINGS. By C. E. Corrigan, B.A., M.D., F.R.C.S.(Eng.). Baltimore: The Williams & Wilkins Co., 1939.

ASSOCIATION FOR RESEARCH IN NERVOUS AND MENTAL DISEASE. Vol. 18 of a Series of Research Publications. THE CIRCULATION OF THE BRAIN AND SPINAL CORD; A SYMPOSIUM ON BLOOD SUPPLY. The Proceedings of the Association, New York, December 27 and 28, 1937. Baltimore: The Williams & Wilkins Co., 1938.

GASTROINTESTINAL DYSFUNCTION. By Barton Arthur Rhinehart, A.B., M.D. Little Rock, Arkansas: Central Printing Co., 1939.

PRIVY COUNCIL MEDICAL RESEARCH COUNCIL. Special Report Series, No. 233. APPENDICITIS; A STATISTICAL STUDY. By Matthew Young and W. T. Russell. London: His Majesty's Stationery Office, 1939.

THE MEDICAL ANNUAL; A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX. Fifty-Seventh Year, 1939. Bristol: John Wright & Sons Ltd.; London: Simpkin Marshall Ltd., 1939.

INTRACRANIAL TUMORS OF INFANCY AND CHILDHOOD. By Percival Bailey, M.D., Douglas N. Buchanan, M.D., and Paul C. Bucy, M.D. Chicago, Illinois: The University of Chicago Press, 1939.

PHYSIOLOGY OF THE UTERUS; WITH CLINICAL CORRELATIONS. By Samuel R. M. Reynolds, M.A., Ph.D. With forewords by George W. Corner, M.D., and Robert T. Frank, M.D., F.A.C.S. New York and London: Paul B. Hoeber, Inc., 1939.

LEHRBUCH DER ROENTGENDIAGNOSTIK. By H. R. Schinz, W. Baensch, and E. Friedl. 4th enl. rev. ed. Vol. 1—SKELETT. Vol. 2—INNERE ORGANE. Leipzig: Georg Thieme, 1939.

VESTNIK CHIRURGII IMENI GREKOVA. Vol. 57, No. 1 and 2–3. Edited by Prof. Djanélidzé. Léningrad: Prospekt Karla Libknechta, 44 log. 44, 1939.

OXFORD MEDICAL PUBLICATIONS. THE MORPHOLOGY OF THE BRACHIAL PLEXUS; WITH A NOTE ON THE PECTORAL MUSCLE AND ITS TENDON TWIST. By Wilfred Harris, M.D., F.R.C.P. New York and London: Oxford University Press, 1939.

THE PHYSIOLOGY AND PHARMACOLOGY OF THE PITUITARY BODY. Vol. II. By H. B. Van Dyke. Chicago, Illinois: The University of Chicago Press, 1939.

CORRESPONDENCE

OBSTETRICAL DIFFICULTIES AFTER INFANTILE PARALYSIS

AN investigation of the obstetrical difficulties in patients who have had infantile paralysis is under way at the Hospital for Joint Diseases, 123d Street and Madison Avenue, in New York City. This study is being pursued under a grant from the National Foundation for Infantile Paralysis. For a proper evaluation, it is essential that as many cases as possible be obtained for study and it is necessary therefore for the investigators to contact a large number of physicians throughout the country.

Drs. Samuel Kleinberg and M. T. Horwitz at the above mentioned address would appreciate hearing from any physician who has a knowledge of any cases of this type.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

HOWARD C. NAFFZIGER, San Francisco, *President*
GEORGE P. MULLER, Philadelphia, *President-Elect*

Committee on Arrangements
THOMAS A. SHALLOW, *Chairman;* L. KRAEER FERGUSON, *Secretary*

PRELIMINARY PROGRAM FOR 1939 CLINICAL CONGRESS

THE surgeons of Philadelphia, under the leadership of strong and representative committees, are planning to present a program of operative clinics and demonstrations for the twenty-ninth annual Clinical Congress of the American College of Surgeons that will cover all phases of the clinical activities of this great medical center. During the five days, October 16–20, the clinicians at the five medical schools and more than 40 participating hospitals will demonstrate to their guests the latest advances in surgical technique and operative procedures. A preliminary schedule of the operative clinics and demonstrations at the hospitals and medical schools appears in the following pages. The program will be revised and amplified during the months preceding the Congress. Clinics will be held on the afternoon of Monday, October 16, and the mornings and afternoons of each of the following four days.

In addition to the ample and well-arranged schedule of operative clinics at which the technique of a wide variety of surgical procedures will be demonstrated in the operating rooms, the committee has arranged a series of non-operative clinics in many of the large hospitals for the presentation of important work being done in many special fields. There will be demonstrations and exhibits covering general surgery, genito-urinary surgery, neurosurgery, fractures and traumatic surgery, obstetrics and gynecology, broncho-esophagology, plastic and faciomaxillary surgery, surgery of the bones and joints, thoracic surgery, ophthalmology and otorhinolaryngology. These programs are being so correlated that the visiting surgeon may be assured of the opportunity to devote his time continuously, if he so desires, to clinics dealing with the special subject in which he may be most interested. The final program will be published and classified according to the various specialties in order to aid the visiting surgeon in the selection of the clinics which he desires to attend. A complete detailed clinical program will be posted in the form of bulletins at headquarters each afternoon for the succeeding day and published in printed form for distribution each morning.

EXECUTIVE COMMITTEE

Thomas A. Shallow, Chairman	Chevalier L. Jackson
L. Kraeer Ferguson, Secretary	Richard H. Meade
William Bates	Thaddeus L. Montgomery
W. E. Burnett	J. T. Nicholson
Edward L. Campbell	John Paul North
J. Montgomery Deaver	Hubley R. Owen
Everett H. Dickinson	Franklin L. Payne
Gilson C. Engel	Warren S. Reese
Theodore R. Fetter	Frederick R. Robbins
Kenneth E. Fry	Thomas J. Ryan
Ralph Goldsmith	Calvin M. Smyth, Jr.
Francis C. Grant	Margaret Sturgis
Robert H. Ivy	

The annual meeting of the governors and fellows of the College will be held in the Rose Garden of the Bellevue-Stratford Hotel on Thursday afternoon at 1:30 o'clock. Reports on activities of the College will be presented by the officers and chairmen of the standing committees.

The attention of fellows is called to the meetings of three important state and provincial committees to be held on Wednesday in the Palm Garden on the first floor of the hotel as follows: Judiciary committees, 9:30 a.m.; Credentials committees, 10 a.m.; Executive committees, 11 a.m.

The showing of surgical motion picture films which so faithfully depict clinical features of major interest to surgeons will be continued at this year's Congress. It is planned to present an enlarged program of both sound and silent pictures at daily exhibits in the Palm Garden of the headquarters hotel.

SCIENTIFIC SESSIONS

The scientific sessions will include certain new features introduced at the Congress in recent years which have met with desired success. The schedule of midday panel discussions has been greatly extended in order that a larger number of the visiting surgeons may have an opportunity to participate.

On Monday the initiates will assemble in the Palm Garden at 11 a.m. in order that the officials of the College may meet them and explain in some detail the aims and objectives of the program of the College. At this same session, the fellowship roll will be signed by the initiates. In the evening, the Presidential Meeting and Convocation will be combined and at this time the new officers inaugurated and the initiates received into fellowship. Dr. Howard C. Naffziger, of San Francisco, will deliver the presidential address, and distinguished surgeons from foreign countries will be introduced.

Scientific meetings will be held in Irvine Hall of the University of Pennsylvania on Tuesday, Wednesday and Thursday evenings in which medical men will co-operate with the surgeons in presenting various phases of the interesting subjects which have been selected for presentation.

As in former years, afternoon symposia have been arranged on the subjects of cancer, fractures and traumatic surgery, urology, obstetrics and gynecology and thoracic surgery. A special feature of the program includes a series of clinical demonstrations to be held at headquarters each morning for those visitors interested in the subjects of ophthalmology and otorhinolaryngology. The subcommittees in charge of these special arrangements are also planning extensive programs of operative clinics in surgery of the eye, ear, nose, and throat to be held in the hospitals each afternoon. Programs for special evening sessions of these groups are being prepared for Tuesday and Thursday evenings.

The midday panel discussions have become of such major interest as a feature of the Congress that the series for this year's meeting will include 15 such sessions. The program will permit the formal and informal discussion of subjects in more restricted fields than would be susceptible of treatment in the general meetings. Attendance at these conferences will necessarily be restricted to the capacity of the rooms in which they will be held. Outstanding authorities have co-operated with the College in the presentation of each one of the selected subjects and will lead, direct and participate in these discussions. The general plan to be followed is that the leader will present the subject to be discussed within a ten minute period, and selected men will discuss various phases of these topics briefly after which general discussion from the floor will be encouraged.

The program committee has aimed to include a selection of material at these various scientific meetings which will make it possible for all of the general surgeons and surgical specialists attending the Congress to learn of the newer developments in their respective specialities.

GRADUATE TRAINING FOR SURGERY

Following the annual meeting of the fellows, scheduled for Thursday afternoon, there will be a conference on graduate training for surgery at 3:00 p.m. Raising the standards of surgery has been a primary purpose of the American College of Surgeons since its organization. This will be accomplished through the present program of the College which has stimulated added interest in this subject on the part of all its fellows and a large number of approved hospitals. The College Committee on Graduate Training for Surgery will present its report of activities for the year through its chairman, Dr. Dallas B. Phemister, of Chicago. Also, at this time, the list of hospitals approved for graduate training for surgery in the United States and Canada will be announced. Leaders in the field of graduate medical education will present and discuss at length the various phases and problems of organization and conduct of graduate training for surgery. This session should be of vital interest to the entire fellowship of the College and many practical suggestions will be offered for developing the needed systematic supervision, preceptorship, and guided instruction for young surgeons.

HOSPITAL CONFERENCES

The twenty-first annual Hospital Standardization Conference will open the Clinical Congress with a session in the Rose Garden at the Bellevue-Stratford Hotel on Monday morning at 10 o'clock. Official announcement of the approved list of hospitals for 1939 will be made at this session.

On Monday afternoon, and on Tuesday, Wednesday and Thursday, both mornings and evenings, an interesting program of papers, round table conferences and practical demonstrations, all dealing with various problems related to efficiency in the hospital will be presented. For Wednesday and Thursday afternoons, at certain local hospitals, there are planned demonstrations in administrative and technical procedures which will be of great interest to the hospital visitors. At the hospital conference on Tuesday afternoon there will

be conducted an administrative panel round table discussion in which an effort will be made to cover as many aspects of hospital administration as possible with particular emphasis on maintenance of high professional standards, current economic problems and trends, and other timely subjects.

A special feature of the hospital conference will be a meeting of hospital executives on Tuesday evening when the program will deal with the future of the voluntary hospital, training of hospital administrators, etc.

At a joint session with the Association of Record Librarians of North America the subject of medical records will be considered from the standpoints of the various specialties of medicine and surgery.

There will be ample opportunity during the Congress for the visitors to inspect the hospitals in Philadelphia and vicinity.

ADVANCE REGISTRATION

The hospitals and medical schools of the Philadelphia area afford accommodations for large numbers of visiting surgeons, but to insure against overcrowding, attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based upon the results of a survey of the operating rooms and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected, therefore, that those surgeons who wish to attend the Congress will register in advance. A registration fee will be required in order to provide funds with which to meet the expenses of the Congress. A formal receipt will be issued to each surgeon registering in advance which is to be exchanged for a general admission card upon his registration at headquarters during the Congress. This card, which is not transferable, must be presented in order to secure clinic tickets and admission to scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows and endorsed junior candidates shall be $5.00; that no fee for the 1939 Congress shall be required of initiates (class of 1939); that the fee for nonfellows attending as invited guests of the College will be $10.00.

As in previous years, admission to clinics and demonstrations at the hospitals will be controlled by means of clinic tickets, which plan provides an efficient means for the distribution of visiting surgeons at the various clinics and assures against overcrowding. The number of tickets issued for any clinic will be limited to the capacity of the room in which the presentation is held.

HEADQUARTERS—TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Bellevue-Stratford Hotel where there are unusual facilities for accommodating the Congress. The Grand Ballroom, Garden, Clover and Red rooms and other large rooms on the first and second floors and the roof have been reserved for scientific exhibits and conferences, registration, clinic ticket bureaus, bulletin boards, executive offices, etc. Thus, the activities of the Congress will be centralized under one roof.

The technical exhibition will be located in the Ballroom and adjacent rooms on the second floor. The registration and clinic ticket bureaus, together with the registration desk, will be centrally located on that floor. The bulletin boards, on which the daily clinical programs will be posted each afternoon, will be distributed through the exhibit rooms. Leading manufacturers of surgical instruments and supplies, x-ray equipment, operating room lights, hospital apparatus of all kinds, ligatures, dressings, pharmaceuticals, and publishers of medical books will be represented in the exhibition.

PHILADELPHIA HOTELS AND THEIR RATES

In addition to the headquarters hotel, the Bellevue-Stratford, there are many first-class hotels within a short walking distance, providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date at the following hotels which are recommended by the committee:

	Minimum rate with bath	
	Single	Double
Adelphia, 13th and Chestnut Sts.	$3.85	$5.50
Barclay, Rittenhouse Square, E.	4.50	7.00
Bellevue-Stratford, Broad and Walnut Sts.	3.85	5.50
Benjamin Franklin, 9th and Chestnut Sts.	3.85	5.50
Colonial, 11th and Spruce Sts.	2.50	3.85
Drake, 1512 Spruce St.	4.00	6.00
Majestic, Broad St. and Girard Ave.	2.50	4.00
Philadelphian, 39th and Chestnut Sts.	2.75	4.40
Ritz Carlton, Broad and Walnut Sts.	3.50	6.00
Robert Morris, 17th and Arch Sts.	2.50	3.50
Spruce, 13th and Spruce Sts.	1.50	2.50
St. James, 13th and Walnut Sts.	2.75	4.50
Sylvania, Juniper and Locust Sts.	3.00	5.00
Walton, Broad and Locust Sts.	2.50	4.00
Warwick, 17th and Locust Sts.	4.50	7.00
Wellington, 19th and Walnut Sts.	4.00	6.00

PRELIMINARY CLINICAL PROGRAM

ARRANGED IN THE FOLLOWING SUBDIVISIONS: GENERAL SURGERY, OBSTETRICS AND GYNECOLOGY, SURGERY OF BONES AND JOINTS, GENITO-URINARY SURGERY, FRACTURES AND TRAUMATIC SURGERY, THORACIC SURGERY, NEUROSURGERY, BRONCHO-ESOPHAGOLOGY, PLASTIC AND FACIOMAXILLARY SURGERY, OPHTHALMOLOGY, OTORHINOLARYNGOLOGY.

GENERAL SURGERY

Monday

HOSPITAL FOR DISEASES OF STOMACH

FRANCIS A. MANTZ—1. Clinic.

AMERICAN ONCOLOGIC HOSPITAL

JOHN W. BRANSFIELD and GORDON CASTIGLIANO. Cancer of breast, operations and demonstration of cases.

JEFFERSON HOSPITAL

HENRY K. MOHLER—2. Therapeutics in surgery.

MOUNT SINAI HOSPITAL

MOSES BEHREND and staff—1:15. Operations.

PENNSYLVANIA HOSPITAL

ORVILLE C. KING—2. Spinal anesthesia.
SAMUEL BRADBURY—4. Surgical follow-up and group practice.

PHILADELPHIA GENERAL HOSPITAL

HUBLEY R. OWEN, JOHN PAUL NORTH, and LEWIS C. MANGES—1:30. Operative and dry clinics.
Staff of Radiological Department—2. Tumor clinic.
I. S. HNELESKI—3. Management of blood bank at Philadelphia General Hospital.
RUBIN M. LEWIS and staff—3:30. Treatment of varicose veins and complications.

STETSON HOSPITAL

ROBERT S. ALSTON, C. E. SCHWARTZ, and TROY MARTIN—2. Operations.
CARL F. KOENIG—2. X-ray clinic.

TEMPLE UNIVERSITY HOSPITAL

CARROLL S. WRIGHT—2. Dermatological and syphilological demonstrations.
WILLIAM A. STEEL and C. HOWARD MCDEVITT—2. General and emergency surgery.
HARRY Z. HIBSHMAN, HARRY E. BACON, and staff—3. Proctological clinic.

WEST JERSEY HOMEOPATHIC HOSPITAL

H. WESLEY JACK and staff—1. Operative clinic: Cholecystectomy.

Tuesday

ABINGTON MEMORIAL HOSPITAL

JOHN EIMAN. Discussion on the chemistry of surgery.

AMERICAN ONCOLOGIC HOSPITAL

GEORGE M. DORRANCE, J. W. BRANSFIELD, and FREDERICK A. BOTHE. Cancer of rectum, operations and demonstration of cases.
JOSEPH MCFARLAND. Cancer of rectum, pathological demonstration.

BRYN MAWR HOSPITAL

JOHN B. FLICK and FREDERICK R. ROBBINS—9. Operations.
MAX STRUMIA—2. Surgical pathology.

CHESTNUT HILL HOSPITAL

JOHN F. MCCLOSKEY, JAMES A. LEHMAN, J. M. ELLZEY, JR., and JOHN J. SHOBER—10. Operations.

FITZGERALD-MERCY HOSPITAL

JAMES A. KELLY—9. Operations.
THOMAS J. RYAN—9. Operations.

FRANKFORD HOSPITAL

LOUIS D. ENGLERTH—9. Operative and dry clinics.

GERMANTOWN HOSPITAL

EDWARD B. HODGE, WILLIAM B. SWARTLEY, ROBERT S. ALSTON, and STEPHEN D. WEEDER—10. Operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYVANIA

WILLIAM BATES—9. Operations.
JOHN C. HOWELL and I. I. GOPADZE—11. Operations.

HAHNEMANN HOSPITAL

A. B. WEBSTER—9. Operations.

HOSPITAL FOR DISEASES OF STOMACH

HERBERT R. HAWTHORNE, WILBUR W. OAKS, and PAUL H. NEESE—9. Clinic.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. S. RAVDIN and staff—9. Operative and dry clinics, biliary tract diseases.

JEANES HOSPITAL

Staff—11. Dry clinic:
W. S. HASTINGS. A review of proposed methods of serological diagnosis of cancer.
A. M. DUFF, JR. The rapid diagnosis of fresh tissue.
HOKE WAMMOCK. The control of pain of advanced cancer with irradiation.
G. A. WHITCOMB. Presentation of treated oral lesions.

JEFFERSON HOSPITAL

CHARLES F. NASSAU—11. Operations, ward walks.
GEORGE P. MULLER—2. Operations.
J. HALL ALLEN and BENJAMIN HASKELL—3. Proctologic surgery.

LANKENAU HOSPITAL

D. B. PFEIFFER, J. MONTGOMERY DEAVER, and DR. MARTIN—9. Operative and dry clinics.

MEMORIAL HOSPITAL

JAMES LEHMAN—9. Thyroid operations.

METHODIST EPISCOPAL HOSPITAL

CALVIN M. SMYTH, JR. and staff—9:30. Operations.

MISERICORDIA HOSPITAL

B. R. BELTRAN and E. GARVIN—9. Operations.
GEORGE P. MULLER, F. MOGAVERO, and F. T. MCGINNIS—9. Operations.

MOUNT SINAI HOSPITAL

BENJAMIN LIPSHUTZ and staff—9. Operations.

NORTHEASTERN HOSPITAL

JOSEPH J. TOLAND—9. Operations.

PENNSYLVANIA HOSPITAL

WALTER E. LEE and staff—9. Operative and dry clinics.

PHILADELPHIA GENERAL HOSPITAL

L. K. FERGUSON and WILLIAM E. ERB—9. Operative and dry clinics.
Staff—2. Symposium on biliary and gastric diseases:
L. K. FERGUSON. Biliary surgery.
TRUMAN G. SCHNABEL. Medical aspects of biliary disease.
ERNEST BURVILLE-HOLMES. X-ray aspects of biliary disease.
W. WAYNE BABCOCK. Gastric surgery.
WILLIAM EGBERT ROBERTSON. Medical aspects of gastric disease.
HERMAN OSTRUM. X-ray aspects of gastric disease.
WILLIAM BRODY. Use of gastroscope in gastric disease.

PRESBYTERIAN HOSPITAL

EDWARD B. HODGE, ERNEST G. WILLIAMSON, and LYNN M. RANKIN—9. Operative and dry clinics.

PROTESTANT EPISCOPAL HOSPITAL

I. M. BOYKIN and staff—9. Operations.

ST. CHRISTOPHER'S HOSPITAL

HENRY KNOX, JOHN WOLF, and DR. MARTIN—10. Pediatric surgery.

ST. JOSEPH'S HOSPITAL

V. G. BURDEN—10. Operations.

ST. LUKE'S AND CHILDREN'S HOSPITAL

DESIDERIO ROMAN, R. W. LARER, H. K. ROESSLER, A. W. HAMMER, JOHN BOWER, and staff—9. Operations.
J. W. POST—9. Roentgenological examinations.
O. F. BARTHMAIER—9. Pathological and bacteriological demonstrations.

ST. MARY'S HOSPITAL

W. J. RYAN and J. J. CANCELMO—9. Operations.
V. R. MANNING—1. Proctological clinic.

ST. VINCENT'S HOSPITAL

J. J. CANCELMO—9. Cryptorchidism, its reduction by operative measures.

TEMPLE UNIVERSITY HOSPITAL

W. WAYNE BABCOCK, G. MASON ASTLEY, W. EMORY BURNETT, and J. NORMAN COOMBS—9. Operations.
W. EDWARD CHAMBERLAIN and staff—9. Radiological clinic.
WILLIAM A. STEEL and C. HOWARD MCDEVITT—2. General and emergency surgery.

WEST JERSEY HOMEOPATHIC HOSPITAL

H. WESLEY JACK and staff—10. Operative clinic: Cholecystectomy and appendectomy.

WOMAN'S MEDICAL COLLEGE HOSPITAL

J. STEWART RODMAN and staff—10. Operations.

WOMEN'S HOMEOPATHIC HOSPITAL

LAWRENCE GOLDBACHER—3. Rectal surgery.

Wednesday

ABINGTON MEMORIAL HOSPITAL

Staff—2. Operations.

BROAD STREET HOSPITAL

A. B. WEBSTER and T. C. GEARY. Operations.

BRYN MAWR HOSPITAL

ARTHUR E. BILLINGS and CHARLES H. HARNEY—9. Operations.

CHESTNUT HILL HOSPITAL

WILLIAM B. SWARTLEY, S. DANA WEEDER, EDWARD F. MCLAUGHLIN, and WILLIAM SWARTLEY RINKER—10:30. Operations.

COOPER HOSPITAL

PAUL M. MECRAY, I. E. DEIBERT, F. W. SHAFER, and R. S. GAMON—9. Abdominal and thoracic surgery, operative and dry clinics.

FITZGERALD-MERCY HOSPITAL

BASIL R. BELTRAN—9. Operations.
ALEXANDER E. BURKE—9. Operations.

FRANKFORD HOSPITAL

BENJAMIN H. CHANDLEE and RALPH W. LORRY—9. Operations.

GERMANTOWN HOSPITAL

CHARLES F. MITCHELL, WALTER E. LEE, HARRY E. KNOX, and THOMAS M. DOWNS—10. Operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WALTER E. LEE—9. Operations.
GEORGE M. PIERSOL, DR. GRIFFITH, and WALTER E. LEE—10. Dry clinic: Calcified constricting pericarditis, medical and surgical aspects.
JOSEPH T. BEARDWOOD, JR., JOSEPH C. YASKIN, and WALTER E. LEE—11. Symposium: Pancreatic adenoma with hyperinsulinism, metabolic, neurologic, and surgical aspects.
COLLIER MARTIN—2. Lymphogranuloma venereum.

HAHNEMANN HOSPITAL

G. A. VAN LENNEP—9. Operations.

HOSPITAL FOR DISEASES OF STOMACH

SHERMAN A. EGER—9. Clinic.
HERBERT R. HAWTHORNE, WILBUR W. OAKS, and PAUL H. NEESE—12. Clinic.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

E. L. ELIASON and staff—9. Operative and dry clinics.
L. K. FERGUSON and DR. LOEFFLAD—2. Varicose vein clinic.
Staff of Harrison Department of Surgical Research—2. Recent advances in pre- and postoperative treatment.

JEFFERSON HOSPITAL

GEORGE P. MULLER and staff—11. Operations.
THOMAS A. SHALLOW—2. Operations: Colon and rectum.

JEWISH HOSPITAL

RALPH GOLDSMITH—9. Operations.
MOSES BEHREND—2. Operations.

LANKENAU HOSPITAL

GEORGE P. MULLER, GILSON C. ENGEL, JOSEPH O. KEEZEL, and HANS MAY—9. Operative and dry clinics. Plastic and faciomaxillary operations by Dr. May.

MEMORIAL HOSPITAL

BRUCE L. FLEMING—9. Operations.

METHODIST EPISCOPAL HOSPITAL

GEORGE J. SCHWARTZ and staff—10. Operations.

MISERICORDIA HOSPITAL

JAMES A. KELLY and D. C. GEIST—9. Operations.

PENNSYLVANIA HOSPITAL

JOHN B. FLICK and staff—9. Operative and dry clinics.
PAUL A. BISHOP—2. Acute intestinal obstruction, with x-ray diagnosis and special reference to the Abbott tube.
WILLIAM A. WOLFF and RUSSELL ELKINTON—4. Chemical control of surgical patients.

PHILADELPHIA GENERAL HOSPITAL

W. WAYNE BABCOCK—9. Dry clinic.
WILLIAM LEMMON—9. Operative clinic: Gall bladder disease.
JOHN O. BOWER, JOHN C. BURNS, and HARRY B. TRACHTENBERG—9. Exhibit on the use of No. 00000 catgut in surgery; management of spreading peritonitis due to perforated appendix with special reference to the use of convalescent lyophilize serum.
HENRY S. RUTH—9. Choice of anesthetics in surgery.

PRESBYTERIAN HOSPITAL

WILLIAM BATES, JAMES B. MASON, and JOHN C. HOWELL 9. Dry clinic.

PROTESTANT EPISCOPAL HOSPITAL

M. L. ALLEN—9. X-ray therapy of inflammation, further experience.
I. M. BOYKIN—9. Problems in gall bladder surgery.
R. L. LAYTON—9. Amputation in diabetic gangrene.
R. H. MEADE, JR.—9. Acute pancreatitis.

ST. JOSEPH'S HOSPITAL

CHARLES F. NASSAU—10. Operations.

ST. LUKE'S AND CHILDREN'S HOSPITAL

DESIDERIO ROMAN, R. W. LARER, H. K. ROESSLER, A. W. HAMMER, JOHN BOWER, and staff—9. Operations.
J. W. POST—9. Roentgenological examinations.
O. F. BARTHMAIER—9. Pathological and bacteriological demonstrations.

ST. MARY'S HOSPITAL

A. P. KEEGAN—9. Operations.

STETSON HOSPITAL

WILLIAM T. ELLIS and J. K. MARKS—12. Operations.
CARL F. KOENIG—2. X-ray clinic.
ROBERT S. ALSTON, C. E. SCHWARTZ, and TROY MARTIN—2. Operations.

TEMPLE UNIVERSITY HOSPITAL

W. WAYNE BABCOCK, G. MASON ASTLEY, W. EMORY BURNETT, and J. NORMAN COOMBS—9. Operations.
W. EDWARD CHAMBERLAIN and staff—9. Radiological clinic.
WILLIAM A. STEEL and C. HOWARD MCDEVITT—2. General and emergency surgery.
HARRY Z. HIBSHMAN, HARRY E. BACON, and staff—3. Proctological clinic.

WOMEN'S HOMEOPATHIC HOSPITAL

R. W. LARER—9. Operations.
WILLIAM L. MARTIN—1. Operations.
C. L. SHOLLENBERGER—1. Operations.

Thursday

ABINGTON MEMORIAL HOSPITAL

DAMON B. PFEIFFER and staff—2. Dry clinic: Peptic ulcer and its surgical complications.

BRYN MAWR HOSPITAL

RALPH S. BROMER—9. X-ray conference.
J. STEWART RODMAN and ALAN P. PARKER—9:30. Operations.

CHESTNUT HILL HOSPITAL

WILLIAM C. SHEEHAN, L. H. HERGESHEIMER, HANS MAY, and H. P. MACNEAL—10. Operations.
FREDERICK K. ALEXANDER—11. Intra-abdominal hernia, x-ray studies.

COOPER HOSPITAL

PAUL M. MECRAY, I. E. DEIBERT, F. W. SHAFER, and R. S. GAMON—9. General surgery and fractures, operative and dry clinics.

FITZGERALD-MERCY HOSPITAL

JAMES A. KELLY—9. Operations.
THOMAS J. RYAN—9. Operations.

FRANKFORD HOSPITAL

CHARLES F. NASSAU—9. Operations.

GERMANTOWN HOSPITAL

EDWARD B. HODGE, WILLIAM B. SWARTLEY, ROBERT S. ALSTON, and STEPHEN D. WEEDER—10. Operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

HERBERT R. HAWTHORNE—9. Operations.

HAHNEMANN HOSPITAL

WILLIAM L. SYLVIS—9. Operations.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. S. RAVDIN and staff—9. Operative and dry clinic, gastro-intestinal disorders.

JEANES HOSPITAL

ROSCOE M. TEAHAN, HOKE WAMMOCK, and CLARENCE A. WHITCOMB—9. Operations: Abdomino-perineal resection of rectum; excision of carcinoma of bladder; implantation of radon for carcinoma of mouth.
Staff—11. Dry clinic:
W. S. HASTINGS. A review of proposed methods of serological diagnosis of cancer.
A. M. DUFF, JR. The rapid diagnosis of fresh tissue.
HOKE WAMMOCK. The control of pain of advanced cancer with irradiation.
G. A. WHITCOMB. Presentation of treated oral lesions.

JEFFERSON HOSPITAL

THOMAS A. SHALLOW and staff—11. Operations.
HOBART A. REIMANN—2. Medico-surgical problems.
J. HALL ALLEN and BENJAMIN HASKELL—3. Proctological operations.

JEWISH HOSPITAL

FRANK B. BLOCK—9. Operations.

METHODIST EPISCOPAL HOSPITAL

CALVIN M. SMYTH, JR. and staff—9. Operations.

MISERICORDIA HOSPITAL

B. R. BELTRAN and E. GARVIN—9. Operations.
GEORGE P. MULLER, F. MOGAVERO, and F. T. MCGINNIS—9. Operations.

MOUNT SINAI HOSPITAL

BENJAMIN LIPSHUTZ and staff—9. Operations.

PENNSYLVANIA HOSPITAL

WALTER E. LEE and staff—9. Operative and dry clinics.

PHILADELPHIA GENERAL HOSPITAL

LOUIS D. ENGLERTH, S. DALE SPOTTS, and HUGH ROBERTSON—9. Operative and dry clinics.
L. K. FERGUSON and WILLIAM E. ERB—9. Operations.
Staff—9. Symposium on metabolic diseases.
EDWARD S. DILLON. Surgical complications of diabetes mellitus.
WILLIAM H. ERB. Diabetic surgery.
ROBERT G. TORREY. Medical aspects of disease of thyroid gland.
PATRICK A. MCCARTHY. Surgery of thyroid gland.
Staff—2. Symposium on cancer preceded by follow-up cancer clinic.
Staff—2. Symposium on general surgery.
LAWRENCE CURTIS—2. Plastic repair after malignancy.

PRESBYTERIAN HOSPITAL

ELDRIDGE L. ELIASON, FREDERICK BOTHE, and JOHN PAUL NORTH—9. Operative and dry clinics.

PROTESTANT EPISCOPAL HOSPITAL

E. T. CROSSAN and staff—9. Operations.

ST. CHRISTOPHER'S HOSPITAL

HENRY KNOX, JOHN WOLF, and DR. MARTIN—10. Pediatric surgery.

ST. JOSEPH'S HOSPITAL

C. S. HERRMAN—9. Operations.
L. D. ENGLERTH—10. Operations.
V. R. MANNING—2. Proctological clinic.

ST. LUKE'S AND CHILDREN'S HOSPITAL

DESIDERIO ROMAN, R. W. LARER, H. K. ROESSLER, A. W. HAMMER, JOHN BOWER, and staff—9. Operations.
J. W. POST—9. Roentgenological examinations.
O. F. BARTHMAIER—9. Pathological and bacteriological demonstrations.

ST. MARY'S HOSPITAL

J. J. TOLAND, JR.—9. Operations.

TEMPLE UNIVERSITY HOSPITAL

W. WAYNE BABCOCK, G. MASON ASTLEY, W. EMORY BURNETT, and J. NORMAN COOMBS—9. Operations.
W. EDWARD CHAMBERLAIN and staff—9. Radiological clinic.
WILLIAM A. STEEL and C. HOWARD MCDEVITT—2. General and emergency surgery.

WEST JERSEY HOMEOPATHIC HOSPITAL

H. WESLEY JACK and staff—10. Operative clinic: Repair of hernias.
H. WESLEY JACK and staff—1. Operative clinic: Carcinoma of breast and appendectomy.

WOMAN'S HOSPITAL OF PHILADELPHIA

CALVIN M. SMYTH, JR. and staff—9. Operations.

Friday

ABINGTON MEMORIAL HOSPITAL

Staff—2. Operations.

AMERICAN ONCOLOGIC HOSPITAL

GEORGE M. DORRANCE, W. S. NEWCOMET, and J. W. BRANSFIELD. Cancer of mouth, operations and demonstration of cases.

BRYN MAWR HOSPITAL

WALTER E. LEE and T. MCKEAN DOWNS—9. Operations.

COOPER HOSPITAL

PAUL M. MECRAY, I. E. DEIBERT, F. W. SHAFER, and R. S. GAMON—9. General, abdominal and thoracic surgery, operative and dry clinics.

FITZGERALD-MERCY HOSPITAL

BASIL R. BELTRAN—9. Operations.
ALEXANDER E. BURKE—9. Operations.

GERMANTOWN HOSPITAL

CHARLES F. MITCHELL, WALTER E. LEE, HARRY E. KNOX, and THOMAS M. DOWNS—10. Operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WALTER E. LEE—9. Operations.
WALTER E. LEE and HENRY LEROY BOCKUS—11. Gastrointestinal clinic.

HAHNEMANN HOSPITAL

THOMAS L. DOYLE—9. Operations: Plastic and general.
HENRY S. RUTH—2. Demonstration of sacral caudal block.
JAMES D. SCHOFIELD and staff—2. Operations.

HOSPITAL FOR DISEASES OF STOMACH

HERBERT R. HAWTHORNE, WILBUR W. OAKS, and PAUL H. NEESE—9. Clinic.
FRANCIS A. MANTZ—1. Clinic.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

E. L. ELIASON and staff—9. Operative and dry clinics.
L. K. FERGUSON, DR. SHIFFER, and LESTER H. HERGESHEIMER—2. Lesions of the anus and anal canal.

JEFFERSON HOSPITAL

P. BROOKE BLAND—9. Operations.
JAMES L. RICHARDS, THOMAS J. COSTELLO, and DAVID M. FARRELL—9. Operations.
CLYDE SPANGLER—10. Ward rounds.
LEWIS C. SCHEFFEY and WILLIAM J. THUDIUM—11:30. Uterine cancer follow-up clinic.
JACOB HOFFMAN—12. Endocrinological clinic.
NORRIS W. VAUX and HOBART A. REIMANN—12. Symposium: Pulmonary complications in obstetrical and surgical practice.
GEORGE P. MULLER and staff—11. Operations.
Staff—1. Regular meeting of tumor clinic, department of neoplastic diseases.

JEWISH HOSPITAL

NORMAN S. ROTHSCHILD—9. Operations.
HENRY TUMEN—9. Gastroscopic clinic.

LANKENAU HOSPITAL

GEORGE P. MULLER, GILSON C. ENGEL, JOSEPH O. KEEZEL, and HANS MAY—9. Operative and dry clinics. Plastic and faciomaxillary operations by Dr. May.

MEMORIAL HOSPITAL

JAMES LEHMAN—9. Operations.

MISERICORDIA HOSPITAL

J. A. KELLY and D. C. GEIST—9. Operations.
T. J. RYAN—9. Operations and symposium on peripheral vascular disease.

MOUNT SINAI HOSPITAL

BENJAMIN LIPSHUTZ and staff—9. Operations.
MOSES BEHREND and staff—1:15. Operations.

PENNSYLVANIA HOSPITAL

JOHN B. FLICK and staff—9. Operative and dry clinics.

PHILADELPHIA GENERAL HOSPITAL

PATRICK A. MCCARTHY—9. Operative and dry clinics.
B. P. WIDMANN—2. Radium and x-ray therapy.

PRESBYTERIAN HOSPITAL

HENRY P. BROWN and ORVILLE C. KING—9. Operative and dry clinics.

PROTESTANT EPISCOPAL HOSPITAL

I. M. BOYKIN and staff—9. Operations.

ST. JOSEPH'S HOSPITAL

JAMES A. KELLY—10. Operations.
EDWARD MALLON. Historical exhibit commemorating the ninetieth anniversary of St. Joseph's Hospital.

ST. LUKE'S AND CHILDREN'S HOSPITAL

DESIDERIO ROMAN, R. W. LARER, H. K. ROESSLER, A. W. HAMMER, JOHN BOWER, and staff—9. Operations.
J. W. POST—9. Roentgenological examinations.
O. F. BARTHMAIER—9. Pathological and bacteriological demonstrations.

ST. MARY'S HOSPITAL

P. A. MCCARTHY—9. Operations.
J. A. KELLY and E. H. WEISS—9. Operations.

STETSON HOSPITAL

WILLIAM T. ELLIS and J. K. MARKS—12. Operations.
CARL F. KOENIG—2. X-ray clinic.
ROBERT S. ALSTON, C. E. SCHWARTZ, and TROY MARTIN—2. Operations.

TEMPLE UNIVERSITY HOSPITAL

W. WAYNE BABCOCK, G. MASON ASTLEY, W. EMORY BURNETT, and J. NORMAN COOMBS—9. Operations.
W. EDWARD CHAMBERLAIN and staff—9. Radiological clinic.
CARROLL S. WRIGHT—2. Dermatological and syphilological clinics.
WILLIAM A. STEEL and C. HOWARD MCDEVITT—2. General and emergency surgery.
HARRY Z. HIBSHMAN and HARRY E. BACON and staff—3. Proctological clinic.

WEST JERSEY HOMEOPATHIC HOSPITAL

H. WESLEY JACK and staff—10. Operative clinic: Carcinoma of breast.
H. WESLEY JACK and staff—1. Operative clinic: Appendectomies.

WOMAN'S MEDICAL COLLEGE HOSPITAL

J. STEWART RODMAN—10. Operative clinic: Breast.
HUBLEY R. OWEN—10. Operative clinic: Hernia.
JAMES LEHMAN—10. Operative clinic: Thyroid.

OBSTETRICS AND GYNECOLOGY

Monday

MEMORIAL HOSPITAL

Z. B. NEWTON—2. Gynecological operations.

PHILADELPHIA GENERAL HOSPITAL

Staff of Radiological Department—2. Tumor clinic.

WOMAN'S HOSPITAL OF PHILADELPHIA

ELEANOR H. BALPH and staff—1. Urological and gynecological clinic.

Tuesday

BROAD STREET HOSPITAL

NEWLIN F. PAXSON and MICHAEL J. BENNETT—9. Dry clinic: Gynecological.

BRYN MAWR HOSPITAL

CHARLES A. BEHNEY—9. Gynecological operations.

COOPER HOSPITAL

T. B. LEE and GORDON F. WEST—9. Operative and dry clinics: Gynecological.

FITZGERALD-MERCY HOSPITAL

JOSEPH V. MISSETT—11. Gynecological operations.

HAHNEMANN HOSPITAL

NEWLIN F. PAXSON and HENRY D. LAFFERTY—9. Clinical pathological conference, ward rounds: Chronic nephritis and pregnancy, placenta praevia, x-ray pelvimetry.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CHARLES C. NORRIS and staff—9. Gynecological operations and demonstrations.
CHARLES C. NORRIS and staff—2. Round table discussion: The treatment of cervical carcinoma. GEORGE GRAY WARD, New York, chairman.

JEANES HOSPITAL

ROSCOE M. TEAHAN, HOKE WAMMOCK, and CLARENCE A. WHITCOMB—9. Operations: Panhysterectomy for carcinoma of uterine fundus, application of radium for carcinoma of cervix; vulvectomy for carcinoma; radical neck dissection for metastatic carcinoma.
Staff—Dry Clinic—11.
W. S. HASTINGS. A review of proposed methods of serological diagnosis of cancer.
A. M. DUFF, JR. The rapid diagnosis of fresh tissue.

HOKE WAMMOCK. The control of pain of advanced cancer with irradiation.
G. A. WHITCOMB. Presentation of treated oral lesions.

JEFFERSON HOSPITAL

P. BROOKE BLAND—9. Gynecological operations.
HARRY STUCKERT—10. Obstetrical ward rounds.
JOHN B. MONTGOMERY—12. Postoperative follow-up clinic.
J. B. BERNSTINE and GEORGE B. BLAND—12. Demonstration of vaccine prevention of puerperal sepsis.
MARIO CASTALLO—12:30. Organization and conduct of obstetrical clinic for the treatment of syphillis and gonorrhea complicating pregnancy; results in ten years' experience.

KENSINGTON HOSPITAL FOR WOMEN

Staff—9. Gynecological operations.

PENNSYLVANIA HOSPITAL

NORRIS W. VAUX and staff—9. Operations and demonstration of cases.
NORRIS W. VAUX and staff—2. Demonstration of Lying-In Hospital technique and procedure:
SPOTSWOOD ROBINS. Admission of patient and assignment to accommodation.
J. VERNON ELLSON. Prenatal care.
CRAIG WRIGHT MUCKLE. Special clinics.
ROBERT M. SHIREY. Preparation of patient for labor.
ROSS B. WILSON. Observation of patient in labor.
CLIFFORD B. LULL. Delivery-room set-up, obstetrical technique and procedures.
JOHN C. ULLERY. Care of the patient immediately postpartum.
ROBERT A. KIMBROUGH. Care of the patient throughout puerperium while in the hospital.
F. SIDNEY DUNNE. Follow-up and end results.
PENDLETON TOMPKINS. Out-patient clinic.
RALPH M. TYSON. Care of the newborn.

PHILADELPHIA GENERAL HOSPITAL

C. A. BEHNEY—11. Dry clinic: Gynecological.

PRESBYTERIAN HOSPITAL

GEORGE M. LAWS, JAMES P. LEWIS and DONALD RIEGEL—2. Gynecological operations.

PRESTON RETREAT

JOHN C. HIRST—2. Demonstration of methods, results and clinical significance of studies of Vitamin A in pregnancy as indicated by visual purple estimation from the Feldman Adaptometer; surgical demonstration of technique of puerperal sterilization from first to fifth postpartum day by means of Pomeroy tubal ligation sterilization through the Pfannenstiel incision under local anesthesia; surgical demonstration of the new Pfannenstiel-B.C. Hirst-Kerr extraperitoneal cesarian section.

ST. LUKE'S AND CHILDREN'S HOSPITAL

WARREN MERCER, LEONARD AVERETT, and staff—9. Operations.

ST. VINCENT'S HOSPITAL

WILLIAM F. MORRISON—10. Female gonorrheal clinic, administering cautery and exhibition of cases which have been cauterized.

STETSON HOSPITAL

STEPHEN E. TRACY and staff—9. Gynecological clinic.

WOMEN'S HOMEOPATHIC HOSPITAL

F. L. HUGHES—9. Gynecological clinic.

WOMAN'S HOSPITAL OF PHILADELPHIA

MARGARET CASTEX STURGIS and staff—9. Gynecological, sterility, operative and dry clinics.
ALBERTA PELTZ and staff—9. Prenatal clinic.

Wednesday

AMERICAN ONCOLOGIC HOSPITAL

STEPHEN TRACY, A. VAUGHAN WINCHELL, and EMMET CICCONE. Cancer of cervix, operations and demonstration of cases.

BRYN MAWR HOSPITAL

JAMES L. RICHARDS—9. Gynecological operations, suspension of uterus and hysterectomy.

CHESTNUT HILL HOSPITAL

EDWARD A. SCHUMANN and CLAYTON T. BEECHAM—9:30. Operations.

FITZGERALD-MERCY HOSPITAL

W. BENSON HARER—9. Gynecological operations.

FRANKFORD HOSPITAL

GEORGE HANNA, JR. and WALLACE MARTIN—1:30. Operative and dry clinics: Obstetrical.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

W. R. NICHOLSON—9. Gynecological operations.
COLLIER MARTIN—2. Lymphogranuloma venereum.

HAHNEMANN HOSPITAL

LEON CLEMMER and NEWLIN F. PAXSON—2. Obstetrical operations.

HOSPITAL FOR DISEASES OF STOMACH

FRANCIS H. EATON—2. Urethral lesions in women.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CARL BACHMAN and staff—9. Obstetrical operations and demonstrations.
DOUGLAS P. MURPHY and PAUL O. KLINGENSMITH—2. Round table discussion: The relative importance of disproportion and inertia uteri in failed trial labor.

JEFFERSON HOSPITAL

BROOKE M. ANSPACH, JOHN B. MONTGOMERY, and staff—9. Operations.
THADDEUS L. MONTGOMERY, MARIO CASTALLO, and CLYDE SPANGLER—9. Operations.
ARTHUR FIRST—12. Endocrin factors in the vitality and development of the fetus.
ABRAHAM RAKOFF—12. New methods in the titration of prolan and estrin; results of such titration in normal and complicated pregnancies.
L. G. FEO—12. Studies in the parasitology and bacteriology of the vagina.
LEOPOLD GOLDSTEIN—12. Glycogen content and acidity of the vagina in pregnancies and its complications.

MEMORIAL HOSPITAL

A. W. VOEGELIN—2. Gynecological operations.

METHODIST EPISCOPAL HOSPITAL

L. C. HAMBLOCK and staff—9. Obstetrical operations and demonstration of Caldwell-Morton apparatus for pelviography.

MOUNT SINAI HOSPITAL

CHARLES MAZER and staff—9. Operations. Exhibit: Investigative problems of the barren marriage (motion pictures).

PENNSYLVANIA HOSPITAL

NORRIS W. VAUX and staff—9. Operations and demonstration of cases.

PRESBYTERIAN HOSPITAL

CHARLES BEHNEY and JOHN GRIFFITH—9. Gynecological clinic.

ST. JOSEPH'S HOSPITAL

HARRY STUCKERT—11. Operative and dry clinics: Obstetrical.
J. F. CARRELL—2. Operative and dry clinics: Obstetrical.
L. A. SOLOFF—3. Pathological demonstration.

ST. MARY'S HOSPITAL

L. J. WOJCZYNSKI—9. Gynecological clinic.
P. J. CARRERAS—9. Obstetrical clinic.
J. M. LAFERTY—1. Obstetrical clinic.
W. H. SCHMIDT—1. Radiological clinic.

WOMAN'S HOSPITAL OF PHILADELPHIA

ALBERTA PELTZ and staff—9. Prenatal clinic.

Thursday

BROAD STREET HOSPITAL

NEWLIN F. PAXSON and MICHAEL J. BENNETT. Operative and dry clinics: Gynecological.

BRYN MAWR HOSPITAL

J. O. GRIFFITHS and J. Y. HOWSON—2. Obstetrical clinic.

COOPER HOSPITAL

T. B. LEE and GORDON WEST—9. Operative and dry clinics: Gynecological.
A. B. DAVIS and G. B. GERMAN—2. Operative and dry clinics: Obstetrical.

FITZGERALD-MERCY HOSPITAL

JOSEPH V. MISSETT—11. Gynecological operations.

HAHNEMANN HOSPITAL

EARL B. CRAIG and FRANK J. FROSCH—9. Operative and dry clinics: Gynecological. 2. Operative and dry clinics: Gynecological.

HOSPITAL FOR DISEASES OF STOMACH

TOBY A. GRECO—9. Interposition and Fothergill operations.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CHARLES C. NORRIS and staff—9. Gynecological operations and demonstrations.
CHARLES C. NORRIS and staff—2. Round table discussion: The diagnosis and treatment of hydatidiform mole and chorion epithelioma.

JEANES HOSPITAL

Staff—11. Dry clinic:
W. S. HASTINGS. A review of proposed methods of serological diagnosis of cancer.
A. M. DUFF, JR. The rapid diagnosis of fresh tissue.
HOKE WAMMOCK. The control of pain of advanced cancer with irradiation.
C. A. WHITCOMB. Presentation of treated oral lesions.

JEFFERSON HOSPITAL

LEWIS C. SCHEFFEY, I. CHARLES LINTGEN, and staff—9. Operations.
CLYDE SPANGLER—10. Ward rounds.
M. M. GINSBERG—10:30. Cystoscopic clinic.
EDWARD BURT—11. Studies in fetal asphyxia.
THADDEUS L. MONTGOMERY—11. Intrapartum factors in fetal and maternal mortality.
JOHN DUGGER—11. A study of the rupture of the uterus.
Staff—12. Round table discussion: The practical application of endocrin therapy in gynecological and obstetrical practice. Emil Novak, Baltimore, chairman.
CHARLES LINTGEN—12. Postoperative follow-up clinic.
BROOKE M. ANSPACH and LEWIS C. SCHEFFEY—3. Clinical conference in gynecology.

MOUNT SINAI HOSPITAL

BERNARD MANN and staff—9. Operations.

NORTHEASTERN HOSPITAL

ALFRED DIEBEL—10. Gynecological operations.

PENNSYLVANIA HOSPITAL

NORRIS W. VAUX and staff—9. Operations and demonstration of cases.
NORRIS W. VAUX and staff—2. Demonstration of Lying-In Hospital technique and procedure:
SPOTSWOOD ROBINS. Admission of patient and assignment to accommodation.
J. VERNON ELLSON. Prenatal care.
CRAIG WRIGHT MUCKLE. Special clinics.
ROBERT M. SHIREY. Preparation of patient for labor.
ROSS B. WILSON. Observation of patient in labor.
CLIFFORD B. LULL. Delivery-room setup, obstetrical technique and procedures.
JOHN C. ULLERY. Care of the patient immediately postpartum.
ROBERT A. KIMBROUGH. Care of the patient throughout puerperium while in the hospital.
F. SIDNEY DUNNE. Follow-up and end results.
PENDLETON TOMPKINS. Out-patient clinic.
RALPH M. TYSON. Care of the newborn.

PRESBYTERIAN HOSPITAL

GEORGE M. LAWS and staff—2. Gynecological operations
PHILLIP F. WILLIAMS—2. Demonstration of prenatal clinic work.

ST. JOSEPH'S HOSPITAL

WILLIAM J. THUDIUM—11. Operative and dry clinics.

ST. LUKE'S AND CHILDREN'S HOSPITAL

WARREN MERCER, LEONARD AVERETT, and staff—9. Operations.

ST. MARY'S HOSPITAL

J. G. SABOL—9. Gynecological clinic.

STETSON HOSPITAL

STEPHEN E. TRACY and staff—9. Gynecological clinic.

WEST JERSEY HOMEOPATHIC HOSPITAL

C. F. HADLEY, E. C. HESSERT, and staff—10:30. Gynecological operations.

WOMAN'S MEDICAL COLLEGE HOSPITAL

CATHARINE MACFARLANE—9. Gynecological clinic.
MARGARET C. STURGIS—9. Uterosalpingography.
ANN GRAY TAYLOR and staff—1. Prenatal clinic.
CATHARINE MACFARLANE—2. Gynecological clinic.

WOMEN'S HOMEOPATHIC HOSPITAL

W. C. MERCER—9. Gynecological clinic.

Friday

BROAD STREET HOSPITAL

W. C. MERCER—Gynecological clinic.

BRYN MAWR HOSPITAL

JOHN B. MONTGOMERY and THOMAS J. COSTELLO—2. Resume of obstetrical clinic.

CHESTNUT HILL HOSPITAL

Z. B. NEWTON and H. CURTIS WOOD—11. Operations.

FITZGERALD-MERCY HOSPITAL

W. BENSON HARER—9. Gynecological operations.

HAHNEMANN HOSPITAL

HENRY L. CROWTHER and RICHARD R. GATES—10. Care of premature baby; management of abortion.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CARL BACHMAN and staff—9. Obstetrical operations and demonstrations.

CARL BACHMAN and staff—12. Round table discussion: Treatment of abortion. Philip F. Williams, chairman.

JEFFERSON HOSPITAL

P. BROOKE BLAND—9. Operations.

JAMES L. RICHARDS, THOMAS J. COSTELLO, and DAVID M. FARRELL—9. Operations.

CLYDE SPANGLER—10. Ward rounds.

LEWIS C. SCHEFFEY and WILLIAM J. THUDIUM—11:30. Uterine cancer follow-up clinic.

JACOB HOFFMAN—12. Endocrinological clinic.

NORRIS W. VAUX and HOBART A. REIMANN—12. Symposium: Pulmonary complications in obstetrical and surgical practice.

KENSINGTON HOSPITAL FOR WOMEN

Staff—9. Obstetrical clinic and demonstration of the work of the Research Foundation.

MOUNT SINAI HOSPITAL

CHARLES MAZER and staff—9. Operations.

PENNSYLVANIA HOSPITAL

NORRIS W. VAUX and staff—9. Operations and demonstration of cases.

PHILADELPHIA GENERAL HOSPITAL

CHARLES S. MILLER and FRANKLIN F. OSTERHOUT—1. Operative and dry clinics: Gynecological.

ST. JOSEPH'S HOSPITAL

D. S. O'DONNELL—11. Operative and dry clinics.

E. W. GILHOOL—2. Operative and dry clinics.

Days to be Announced

JEWISH HOSPITAL

C. J. STAMM, JACOB WALKER, and PHILIP F. WILLIAMS. Operations.

PRESBYTERIAN HOSPITAL

CHARLES BEHNEY. Operative and dry clinics: Gynecological.

PHILIP F. WILLIAMS and COLLIN FOULKROD. Operative and dry clinics: Obstetrical.

TEMPLE UNIVERSITY HOSPITAL

FRANK C. HAMMOND and staff. Gynecological operative and dry clinics.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Scientific Exhibits—Laboratory of Obstetrics and Gynecology

DOUGLAS P. MURPHY. Tokographic studies of uterine motility during pregnancy and labor.

PAUL O. KLINGENSMITH. Exhibits showing the influence of variations in pelvic configuration upon the mechanism of labor.

CARL BACHMAN. Exhibits showing the techniques for the quantitative determination of estrogens and pregnandiol in pregnancy urine.

FRANKLIN L. PAYNE. Hormone studies in hydatidiform mole and chorion epithelioma.

F. SIDNEY DUNNE. Functioning ovarian tumors.

GENITO-URINARY SURGERY

Monday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

JOSEPH C. BIRDSALL and staff—2. Operative and dry clinics.

PENNSYLVANIA HOSPITAL

GARFIELD G. DUNCAN—3. Management of diabetes during acute infections and surgical complications.

ST. JOSEPH'S HOSPITAL

WILLIAM J. EZICKSON—2. Operative and dry clinics.

ST. MARY'S HOSPITAL

W. H. HAINES—1. Operative and dry clinics.

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3. Operative and dry clinics.

Tuesday

GERMANTOWN HOSPITAL

STANLEY Q. WEST and HAROLD S. RAMBO—10. Operative and dry clinics.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WILLIAM H. MACKINNEY and EDWARD A. MULLEN—2. Operative and dry clinics.

HAHNEMANN HOSPITAL

LEON T. ASHCRAFT and WILLIAM HUNSICKER, JR.—2. Operations.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ALEXANDER RANDALL and staff—2. Operations.

JEFFERSON HOSPITAL

D. M. DAVIS—9. Diagnostic clinic, ward walk.

JEWISH HOSPITAL

JOHN B. LOWNES—9. Operations.
LEON SOLIS-COHEN—9. Urological radiological exhibit.

MOUNT SINAI HOSPITAL

MAURICE MUSCHAT and staff—1:30. Operations.

PROTESTANT EPISCOPAL HOSPITAL

A. E. BOTHE—2. Operations.

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3. Operative and dry clinics.

U. S. NAVAL HOSPITAL

Staff—9. Operative and dry clinics.

Wednesday

ABINGTON MEMORIAL HOSPITAL

ALEXANDER RANDALL and staff—9. Operations.

CHESTNUT HILL HOSPITAL

ALEXANDER RANDALL, FREDERICK S. SCHOFIELD, and FRANK P. MASSANISO—11. Operations.

COOPER HOSPITAL

D. F. BENTLEY and R. BETANCOURT—2. Operative and dry clinics.

GERMANTOWN HOSPITAL

JOHN B. LOWNES, F. S. SCHOFIELD, and FRANK P. MASSANISO—10. Operative and dry clinics.

HAHNEMANN HOSPITAL

LEON T. ASHCRAFT and WILLIAM HUNSICKER, JR.—9. Operations.

JEFFERSON HOSPITAL

D. M. DAVIS and staff—9. Operations.
KARL KORNBLUM—9. Roentgenological exhibit, urological cases.

LANKENAU HOSPITAL

C. A. W. UHLE—12:15. Rupture of the posterior urethra.

PRESBYTERIAN HOSPITAL

JOSEPH C. BIRDSALL, FRANCIS G. HARRISON, and HENRY SANGREE—2. Operative and dry clinics.

ST. LUKE'S AND CHILDREN'S HOSPITAL

E. W. CAMPBELL, L. F. MILLIKEN, and staff—9. Operative and dry clinics.

ST. MARY'S HOSPITAL

W. H. HAINES—2. Operations.

Thursday

AMERICAN ONCOLOGIC HOSPITAL

A. E. BOTHE and EMMET CICCONE. Cancer of genito-urinary tract, operations and demonstration of cases.

CHESTNUT HILL HOSPITAL

FREDERICK S. SCHOFIELD—9. Operations.

GERMANTOWN HOSPITAL

STANLEY Q. WEST and HAROLD S. RAMBO—10. Operative and dry clinics.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ALEXANDER RANDALL and staff—2. Operative and dry clinics.

JEFFERSON HOSPITAL

D. M. DAVIS and staff—9. Operations.

MEMORIAL HOSPITAL

E. A. MULLEN—3. Operations.

MISERICORDIA HOSPITAL

A. E. BOTHE—2. Operations.

MOUNT SINAI HOSPITAL

MAURICE MUSCHAT and staff—1:30. Operations.

PENNSYLVANIA HOSPITAL

LEON HERMAN and staff—2. Operative and dry clinic.

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3. Operative and dry clinics.

U. S. NAVAL HOSPITAL

Staff—9. Operations.
Staff—3. Dry clinic.

WOMAN'S MEDICAL COLLEGE HOSPITAL

FAITH S. FETTERMAN—9. Operative and dry clinics.

WOMEN'S HOMEOPATHIC HOSPITAL

LEON T. ASHCRAFT—2:30. Operative and dry clinics.

Friday

ABINGTON MEMORIAL HOSPITAL

ALEXANDER RANDALL and staff—9. Operations.

BRYN MAWR HOSPITAL

LEON HERMAN and LLOYD GREENE—2. Operations.

GERMANTOWN HOSPITAL

JOHN B. LOWNES, F. S. SCHOFIELD, and FRANK P. MASSANISO—10. Operative and dry clinics.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

J. BIRDSALL—2. Operative and dry clinics.

HAHNEMANN HOSPITAL

LEON T. ASHCRAFT and WILLIAM HUNSICKER, JR.—9. Operations.

JEFFERSON HOSPITAL

D. M. DAVIS and staff—9. Operations.

JEWISH HOSPITAL

JOHN B. LOWNES—9. Operations.
LEON SOLIS-COHEN—9. Urological radiological exhibit.

LANKENAU HOSPITAL

WILLIAM H. MACKINNEY and C. A. W. UHLE—2. Operations.

METHODIST EPISCOPAL HOSPITAL

STERLING MOOREHEAD and staff—10. Operations.

MISERICORDIA HOSPITAL

A. E. BOTHE—2. Dry clinic: Kidney tumors, types and treatment.

PHILADELPHIA GENERAL HOSPITAL

Staff—2. Operative and dry clinics.

ST. LUKE'S AND CHILDREN'S HOSPITAL

E. W. CAMPBELL, L. F. MILLIKEN and staff—9. Operative and dry clinics.

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3. Operative and dry clinics.

WOMAN'S HOSPITAL OF PHILADELPHIA

FAITH S. FETTERMAN and staff—9. Urological dry clinic.

SURGERY OF BONES AND JOINTS

Monday

CHILDREN'S HOSPITAL

J. T. NICHOLSON—2. Operations.

MOUNT SINAI HOSPITAL

M. B. COOPERMAN—2. Operations.

PROTESTANT EPISCOPAL HOSPITAL

RUTHERFORD L. JOHN—1:30. Operative and dry clinics.

Tuesday

COOPER HOSPITAL

B. FRANKLIN BUZBY, OSWALD R. CARLANDER, and DR. WALLIS—9. Operative and dry clinics.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

DEFOREST P. WILLARD, JESSE T. NICHOLSON, and BENJAMIN T. BELL—9. Operative and dry clinics.

ST. JOSEPH'S HOSPITAL

PAUL JEPSON—1. Operative and dry clinics.

ST. LUKE'S AND CHILDREN'S HOSPITAL

JOHN A. BROOKE—2. Operations.

SHRINERS' HOSPITAL

J. R. MOORE—2. Ward walk.

WOMEN'S HOMEOPATHIC HOSPITAL

E. O. GECKELER—1. Operative and dry clinics.

Wednesday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

W. G. ELMER, L. D. FRESCOLN, and PAUL JEPSON—12. Operations.

JEFFERSON HOSPITAL

J. T. RUGH—9. Operations.

MOUNT SINAI HOSPITAL

M. B. COOPERMAN and staff—2. Operations.

PHILADELPHIA GENERAL HOSPITAL

Staff—2. Symposium on orthopedic surgery.
W. G. ELMER, L. D. FRESCOLN, and PAUL JEPSON—3. Operations.

PROTESTANT EPISCOPAL HOSPITAL

J. W. KLOPP—9. Fractures of neck of femur, use of nailing in treatment.
RUTHERFORD L. JOHN—1:30. Operative and dry clinics.

ST. CHRISTOPHER'S HOSPITAL

RUTHERFORD L. JOHN—10:30. Operations.

ST. LUKE'S HOSPITAL

PAUL JEPSON—10. Operations.

SHRINERS' HOSPITAL

J. R. MOORE—9. Operations.

WEST JERSEY HOMEOPATHIC HOSPITAL

S. L. BROWN and staff—9. Operations.

Thursday

BRYN MAWR HOSPITAL

GEORGE WAGONER—9. Operations.

GERMANTOWN HOSPITAL

B. FRANKLIN BUZBY and A. D. WALLIS—9. Operative and dry clinics.

HAHNEMANN HOSPITAL

JOHN A. BROOKE, EDWIN GECKELER, and DONALD T. JONES—2. Dry clinic: Fractures of neck of femur, internal fixation, Smith-Petersen pin or parallel screws; results of leg shortening; herniation of intervertebral disc; shoulder disabilities; orthopedic problem cases for discussion.

PHILADELPHIA ORTHOPAEDIC HOSPITAL

DE FOREST P. WILLARD and Staff—9. Operations.

ST. JOSEPH'S HOSPITAL

PAUL JEPSON—1. Operative and dry clinics.

SHRINERS' HOSPITAL

J. R. MOORE—9. Out-patient clinic.

TEMPLE UNIVERSITY HOSPITAL

J. R. MOORE—1. Operations.

Friday

COOPER HOSPITAL

B. FRANKLIN BUZBY, OSWALD R. CARLANDER, and DR. WALLIS—9. Operative and dry clinics.

JEWISH HOSPITAL

A. M. RECHTMAN, E. A. BRAV, HENRY SIGMOND, and M. T. HORWITZ—9. Dry clinic.

MOUNT SINAI HOSPITAL

M. B. COOPERMAN and staff—2. Operations.

ST. CHRISTOPHER'S HOSPITAL

RUTHERFORD L. JOHN—10:30. Operations.

SHRINERS' HOSPITAL

J. R. MOORE—9. Operations.

Days to be Announced

PRESBYTERIAN HOSPITAL

BRUCE GILL. Operative and dry clinics.

FRACTURES AND TRAUMATIC SURGERY

Monday

PROTESTANT EPISCOPAL HOSPITAL

I. M. Boykin—2. Fractures of lower third of leg, industrial clinic.

Tuesday

ABINGTON MEMORIAL HOSPITAL

Staff—3. Fracture clinic.

JEWISH HOSPITAL

Moses Behrend—9. Compound fractures, immediate fixation and metal plates.

Ralph Goldsmith and staff—9. Fracture clinic.

PRESBYTERIAN HOSPITAL

John Paul North—9. Industrial surgery.

TEMPLE UNIVERSITY HOSPITAL

John Royal Moore—9. Fracture clinic.

WEST JERSEY HOMEOPATHIC HOSPITAL

H. Wesley Jack and staff—1. Operative and dry clinic, discussion and presentation of four cases of traumatic removal of spleen.

Wednesday

COOPER HOSPITAL

Staff—9. Clinic.

NORTHEASTERN HOSPITAL

T. Turner Thomas—11. Moving picture demonstration.

PHILADELPHIA GENERAL HOSPITAL

Clay Murray, S. Hudock, Harrison McLaughlin, and B. F. Buzby—2. Symposium.

ST. JOSEPH'S HOSPITAL

James A. Lehman—9. Industrial surgery, living fascial suture in repair of hernia.

Thursday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Robert A. Groff—9. Responsibility of industry in the management of head injuries, industrial surgery.

Bernard D. Judovitch—10. Industrial surgery: Back injuries.

John C. Howell—11. Industrial surgery: Restoration of joint function after fractures; pain in groin following lifting; tendon repair.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

L. K. Ferguson and Louis Kaplan—2. Fractures.

JEWISH HOSPITAL

Ralph Goldsmith and staff—9. Fracture clinic.

MEMORIAL HOSPITAL

Bruce L. Fleming—9. Fracture clinic.

PENNSYLVANIA HOSPITAL

Frederick R. Robbins—9. Industrial clinic.

Friday

COOPER HOSPITAL

R. S. Gamon and E. R. Ristine—9. Clinic.

ST. MARY'S HOSPITAL

W. J. Ryan—9. Operative and dry clinics, industrial surgery.

NEUROSURGERY

Tuesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Francis C. Grant—9. Operations.

JEFFERSON HOSPITAL

William Duane, Jr.—9. Operations.

TEMPLE UNIVERSITY HOSPITAL

Temple Fay—9. Operations.

Wednesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Walter I. Lillie—10. Fundus changes associated with neurosurgical conditions.

MISERICORDIA HOSPITAL

T. J. Ryan—9. Operations and symposium on craniocerebral injuries.

TEMPLE UNIVERSITY HOSPITAL

Temple Fay—9. Operations.

Thursday

JEFFERSON HOSPITAL

William Duane, Jr.—9. Operations.

Friday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Francis C. Grant—9. Operations.

JEFFERSON HOSPITAL

Bernard M. Alpers and William Duane, Jr.—10. Brain tumors, diagnosis and treatment.

PHILADELPHIA GENERAL HOSPITAL

Staff—9. Operations.

TEMPLE UNIVERSITY HOSPITAL

Temple Fay—9. Operations.

THORACIC SURGERY

Tuesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. S. RAVDIN—2. Dry clinics: Thoracic diseases.

JEFFERSON HOSPITAL

HOWARD H. BRADSHAW and GEORGE WILLAUER—11:30. Dry clinic: Thoracic diseases.

MISERICORDIA HOSPITAL

J. A. SHARKEY—3. Talk on postpartum pulmonary complications.

PHILADELPHIA GENERAL HOSPITAL

Staff—9. Symposium on empyema, pneumonia, sulfanilamide, and sulfapyridine.
E. L. ELIASON. Empyema.
RUSSELL S. BOLES. Pneumonia.
ERNEST BURVILLE-HOLMES. X-ray aspects of empyema and pneumonia.
LEON SCHWARTZ. Clinical studies on sulphapyridine.

MOSES BEHREND, RICHARD H. MEADE, JR., RUBIN M. LEWIS, and ALBERT BEHREND—2. Operative and dry clinics: The phrenic nerve, pneumonolysis, thoracoplasty, extrapleural pneumothorax.

Wednesday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WALTER E. LEE—10. Dry clinic: Constrictive pericarditis.

JEFFERSON HOSPITAL

HOWARD H. BRADSHAW and GEORGE WILLAUER—2. Operative clinic: Thoracic diseases.

PENNSYLVANIA HOSPITAL

JOHN B. FLICK and staff—9. Operative and dry clinics: Thoracic diseases.

JOHN T. BAUER—3. Carcinoma of the lung, diagnosis by sputum examination.

PHILADELPHIA GENERAL HOSPITAL

V. W. MURRAY WRIGHT—9. Wound and pulmonary complications, postoperative care.

PROTESTANT EPISCOPAL HOSPITAL

RICHARD H. MEADE—9. Thoracoplasty for pulmonary tuberculosis, operative and dry clinics.

Thursday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

J. W. CUTLER—2. Extrapleural and intrapleural pneumolysis in surgical therapy of tuberculosis.

PHILADELPHIA GENERAL HOSPITAL

MOSES BEHREND and staff—2. Operative clinic: Tuberculosis.

TEMPLE HOSPITAL

W. EMORY BURNETT—9. Operative clinic: Thoracic diseases.

Staff—2. Dry clinics: Thoracic diseases, followed by chest conference.

PLASTIC AND FACIOMAXILLARY SURGERY

Monday

CHESTNUT HILL HOSPITAL

CHARLES W. GAISER—2. Operations.

Tuesday

AMERICAN ONCOLOGIC HOSPITAL

GEORGE M. DORRANCE and JOHN W. BRANSFIELD—2. Operations.

JEFFERSON HOSPITAL

WARREN B. DAVIS—9. Operations.

PENNSYLVANIA HOSPITAL

JAMES R. CAMERON—2. Operations.

PRESBYTERIAN HOSPITAL

ROBERT IVY and LAWRENCE CURTIS—9. Operative and dry clinics, facial reconstructions.

Thursday

AMERICAN ONCOLOGIC HOSPITAL

GEORGE M. DORRANCE and JOHN W. BRANSFIELD—2. Operations.

JEFFERSON HOSPITAL

WARREN B. DAVIS—9. Operations.

Friday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ROBERT H. IVY and LAWRENCE CURTIS—9. Operations.

MOUNT SINAI HOSPITAL

V. FRANK—2. Operations.

ST. JOSEPH'S HOSPITAL

WILLIAM J. MCKINLEY—9. Operative and dry clinic.

BRONCHO-ESOPHAGOLOGY

Monday

CHESTNUT HILL HOSPITAL

CHEVALIER L. JACKSON—3. Operations.

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER L. JACKSON—1. Broncho-esophagology.

Tuesday

JEWISH HOSPITAL

L. H. CLERF, R. M. LUKENS, and C. J. SWALM—3. Bronchoscopic clinic.

PHILADELPHIA GENERAL HOSPITAL

GEORGE L. WHELAN—9. Bronchoscopic clinic.

PROTESTANT EPISCOPAL HOSPITAL
WILLIAM A. LELL—2. Bronchoscopic clinic.

Wednesday

JEFFERSON HOSPITAL
L. H. CLERF—9. Bronchoscopic clinic.

MISERICORDIA HOSPITAL
GABRIEL TUCKER, JOSEPH P. ATKINS, and WILLIAM A. LELL—2. Operative and dry clinics.

MOUNT SINAI HOSPITAL
W. A. LELL and staff—10. Operative and dry clinics.

PHILADELPHIA GENERAL HOSPITAL
LOUIS H. CLERF—1. Bronchoscopic clinic, malignancy of air passages.

WOMAN'S MEDICAL COLLEGE HOSPITAL
EMILY VAN LOON and staff—9. Bronchoscopic clinic.

Thursday

FRANKFORD HOSPITAL
GEORGE A. RICHARDSON—1:30. Bronchoscopic clinic.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
GABRIEL TUCKER—9. Bronchoscopic clinic.

JEFFERSON HOSPITAL
L. H. CLERF—1. Bronchoscopic clinic.

ST. CHRISTOPHER'S HOSPITAL
EMILY VAN LOON—9. Bronchoscopy in allergic children.

TEMPLE UNIVERSITY HOSPITAL
CHEVALIER L. JACKSON—1. Broncho-esophagology.

Friday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
GABRIEL TUCKER and WALTER E. LEE—10. Esophageal diverticula, surgical management.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
GABRIEL TUCKER and staff—9. Bronchoscopic clinic.

OTORHINOLARYNGOLOGY

Monday

BRYN MAWR HOSPITAL
EDWIN P. LONGAKER—2. Operations.

CHESTNUT HILL HOSPITAL
B. D. PARISH, FRED E. TRAGANZA, and WILLIAM J. HITSCHLER. Operations.

CHILDREN'S HOSPITAL
WILLIAM HEWSON—1. Sinus infections in children, diagnosis and treatment, out-patient clinic.
LLOYD S. HUTCHISON and MALCOLM N. WILMES—3. Tonsillectomy in children, operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
RALPH BUTLER and WALTER ROBERTS—2. Operative and dry clinics.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
HARRY P. SCHENCK and LOUIS E. SILCOX—2. Operations.

JEWISH HOSPITAL
H. M. GODDARD—2. Operative clinic: Submucous resections; tonsillectomies; maxillary sinus disease.

MOUNT SINAI HOSPITAL
M. S. ERSNER—2:30. Operations.

NORTHERN LIBERTIES HOSPITAL
SAMUEL COHEN—2. Nasal plastic surgery.

PENNSYLVANIA HOSPITAL
WILLIAM HEWSON and THOMAS GOWEN—2. Operations (out-patient clinic).
EDWARD H. CAMPBELL—2. Diagnostic methods in nose and throat conditions (out-patient clinic).

PHILADELPHIA GENERAL HOSPITAL
HERBERT M. GODDARD—2. Tonsil and submucous clinic.

PRESBYTERIAN HOSPITAL
WALTER L. CARISS, DOUGLAS MACFARLAN, RICHARD W. GARLICHS, and E. W. KEMNER—2. Operative and dry clinics.

ST. JOSEPH'S HOSPITAL
T. F. GOWEN—1. Operative and dry clinics.

ST. MARY'S HOSPITAL
E. J. MURPHY—1. Operations.

TEMPLE UNIVERSITY HOSPITAL
ROBERT F. RIDPATH and staff—2. Rhinological clinic.

WOMAN'S HOSPITAL OF PHILADELPHIA
HENRIETTA TUCKER TANNER—2. Tonsillectomy and adnoidectomy.

Tuesday

COOPER HOSPITAL
ORAM R. KLINE, ERNEST R. HIRST, and staff—2. Operations.

FITZGERALD-MERCY HOSPITAL
CORNELIUS T. MCCARTHY—1. Radical mastoidectomy, report on three cases of lateral sinus thrombosis with recovery. Treatment of otolaryngological cases with sulphanilamide.

FRANKFORD HOSPITAL
ROBERT WATT—1:30. Operative and dry clinics.

GERMANTOWN HOSPITAL
H. J. WILLIAMS, C. B. OWINGS, C. E. TOWSON, VALENTINE MILLER, and WILLIAM J. HITSCHLER—2. Operative and dry clinics.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GEORGE M. COATES and BENJAMIN H. SHUSTER—2. Otolaryngological and neuro-otological operative and dry clinics.

HAHNEMANN HOSPITAL

CHARLES B. HOLLIS—2. Operations.

HOSPITAL FOR DISEASES OF STOMACH

ROBERT J. HUNTER—2. Functional ear test.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER and staff—9. Direct laryngoscopy.
JULIUS WINSTON and D. S. BOSTWICK—2. Operations.
GABRIEL TUCKER—2. Dry clinic: Laryngeal tumors, benign and malignant. (Colored motion pictures).

JEFFERSON HOSPITAL

L. H. CLERF—9. Cancer of larynx.
H. H. LOTT—9. Tonsil clinic.
H. J. WILLIAMS—1. Dry clinic: Facial paralysis occurring during the course of chronic suppurative otitis media and its treatment.

LANKENAU HOSPITAL

RALPH BUTLER, ROBERT J. HUNTER, and EDWARD H. CAMPBELL—2. Operations.

METHODIST EPISCOPAL HOSPITAL

WALTER ROBERTS and staff—2. Operations.

MISERICORDIA HOSPITAL

R. J. BRENNAN—2. Talk on treatment of sinusitis.

MOUNT SINAI HOSPITAL

D. N. HUSIK—1:30. Operations.

PENNSYLVANIA HOSPITAL

ORAM KLINE, HENRY A. MILLER, and HOWARD HEBBLE—2. Operations (out-patient clinic).
ROMEO A. LUONGO and ANTHONY C. BRANCATO—2. Diagnostic methods in nose and throat conditions.
LOUIS E. SILCOX—2. Tonsillectomy, general anesthesia.

PHILADELPHIA GENERAL HOSPITAL

LOUIS J. BURNS—2. Laryngeal tuberculosis.

ST. JOSEPH'S HOSPITAL

ARTHUR WRIGLEY—11. Operative and dry clinics.

ST. LUKE'S AND CHILDREN'S HOSPITAL

GEORGE MACKENZIE, SETH BRUMM, WILLIAM WHELAN, BENJAMIN SHUSTER, and staff—9. Operations.

ST. MARY'S HOSPITAL

W. P. GRADY—9. Operative and dry clinics.

TEMPLE UNIVERSITY HOSPITAL

MATTHEW S. ERSNER and staff—2. Otological clinic.

WEST JERSEY HOMEOPATHIC HOSPITAL

E. S. HALLINGER and staff—2. Operations.

Wednesday

CHESTNUT HILL HOSPITAL

JOHN R. DAVIES, JR., GEORGE T. FARIS, and Darius G. ORNSTON—1:30. Operations.

CHILDREN'S HOSPITAL

F. HAROLD KRAUSS—1. Sinus infections in children, diagnosis and treatment, out-patient clinic. 3. Tonsil and mastoid operations.

FITZGERALD-MERCY HOSPITAL

J. E. LOFTUS—1. Mastoid operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GEORGE B. WOOD—2. Operative and dry clinics.
SAMUEL COHEN—3. Nasal plastic operation.

HAHNEMANN HOSPITAL

JOSEPH V. CLAY—2. Operations.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

EDWARD H. CAMPBELL and OSCAR BATSON—2. Operations.

JEFFERSON HOSPITAL

A. T. SMITH—10. Tumors of nose and sinuses.
H. J. WILLIAMS—1. Operative and dry clinics.

JEWISH HOSPITAL

A. S. KAUFMAN—1. Mastoid surgery.

MISERICORDIA HOSPITAL

C. T. MCCARTHY—2. Tonsillectomy, local, LaForce; dissection; submucous resection; simple and radical mastoid; results of sulphanilamide in mastoiditis.

PHILADELPHIA GENERAL HOSPITAL

ROBERT J. HUNTER—2. Recent advances in otology; ward walk, laryngeal clinic.

PROTESTANT EPISCOPAL HOSPITAL

OTTO C. HIRST and staff—2. Operations.

ST. CHRISTOPHER'S HOSPITAL

F. HAROLD KRAUSS and GOMER T. WILLIAMS—2. Operations.

ST. JOSEPH'S HOSPITAL

R. L. DICKSON—11. Operative and dry clinics.

ST. LUKE'S AND CHILDREN'S HOSPITAL

GEORGE MACKENZIE, SETH BRUMM, WILLIAM WHELAN, BENJAMIN SHUSTER, and staff—9. Operations.

STETSON HOSPITAL

C. H. GRIMES and staff—12. Operative and dry clinics.

TEMPLE UNIVERSITY HOSPITAL

ROBERT F. RIDPATH and staff—2. Rhinological clinic.

WEST JERSEY HOMEOPATHIC HOSPITAL

E. S. HALLINGER and staff—2. Operations.

WOMAN'S HOSPITAL OF PHILADELPHIA

CATHERINE ARTHURS and staff—2. Operations.

Thursday

BRYN MAWR HOSPITAL

CHARLES A. PRYOR—2. Operations.

FITZGERALD-MERCY HOSPITAL

CORNELIUS T. MCCARTHY—1. Operations.

GERMANTOWN HOSPITAL

H. J. Williams, C. B. Owings, C. E. Towson, Valentine Miller, and William J. Hitschler—2. Operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Ralph Butler and Walter Roberts. Operative and dry clinics.

HAHNEMANN HOSPITAL

Charles B. Hollis—2. Operations.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Edward J. Donnelley and Harry Schluderberg—2. Operations.

JEFFERSON HOSPITAL

A. T. Smith—9. Tonsil clinic. 1. Sinus clinic.

JEWISH HOSPITAL

H. B. Cohen—1. Operations.

LANKENAU HOSPITAL

Ralph Butler, Robert J. Hunter, and Edward H. Campbell—2. Operations.

MEMORIAL HOSPITAL

Horace Williams—2. Radical mastoid operations.

METHODIST EPISCOPAL HOSPITAL

Walter Roberts and staff—2. Operations.

MISERICORDIA HOSPITAL

J. E. Loftus—2. Dry clinic: Mastoid Surgery.

MOUNT SINAI HOSPITAL

Morris A. Weinstein—2. Operations.

PENNSYLVANIA HOSPITAL

William Hewson, Oram Kline, and Romeo Luongo—2. Operations (out-patient clinic).
William Hewson, Howard Hebble, and Louis E. Silcox—2. Diagnostic methods in nose and throat conditions.
Edward H. Campbell—2. Mastoid operations.

PHILADELPHIA GENERAL HOSPITAL

Benjamin H. Shuster—2. Laryngeal tuberculosis.

PROTESTANT EPISCOPAL HOSPITAL

Allen Bertolet and staff—2. Operations.
Otto C. Hirst and staff—2. Operations.

ST. LUKE'S AND CHILDREN'S HOSPITAL

George Mackenzie, Seth Brumm, William Whelan, Benjamin Shuster, and staff—9. Operations.

ST. MARY'S HOSPITAL

E. J. Holland—1. Operative and dry clinics.

TEMPLE UNIVERSITY HOSPITAL

Matthew S. Ersner and staff—2. Otological clinic.

WEST JERSEY HOMEOPATHIC HOSPITAL

E. S. Hallinger and staff—2. Operations.

Friday

CHILDREN'S HOSPITAL

Edward H. Campbell—1. Sinus infections in children, diagnosis and treatment, out-patient clinic, 3. Mastoid operations.

FITZGERALD-MERCY HOSPITAL

J. E. Loftus—1. Operations.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Karl M. Houser and Harry Schluderberg—2. Operations.

PENNSYLVANIA HOSPITAL

Thomas Gowen and Henry A. Miller—2. Operations (out-patient clinic).
Thomas Gowen and Edward J. Gough—2. Diagnostic methods in nose and throat conditions.
Thomas Gowen and William Danehower—2. Operations: Tonsil and mastoid.

PHILADELPHIA GENERAL HOSPITAL

David N. Husik—2. Operative and dry clinics.

ST. CHRISTOPHER'S HOSPITAL

F. Harold Krauss and Gomer T. Williams—10. Operations.

ST. LUKE'S AND CHILDREN'S HOSPITAL

George Mackenzie, Seth Brumm, William Whelan, Benjamin Shuster, and staff—9. Operations.

ST. MARY'S HOSPITAL

T. J. Walsh—1. Operative and dry clinics.

TEMPLE UNIVERSITY HOSPITAL

Robert F. Ridpath and staff—2. Rhinological clinic.

WOMEN'S HOMEOPATHIC HOSPITAL

J. R. Criswell and C. J. V. Fries—2. Operative and dry clinics.

Days to be Announced

ABINGTON MEMORIAL HOSPITAL

Walter Hughson. Demonstration of the physiology of hearing.
Frederick Krauss. Discussion on mastoids.

OPHTHALMOLOGY

Monday

COOPER HOSPITAL

J. S. Shipman and staff—2. Operative and dry clinics.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

L. C. Peter—2. Dry clinic.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

F. H. Adler—2. Operative and dry clinics.

JEFFERSON HOSPITAL

C. E. G. Shannon—2. Operative and dry clinics.

LANKENAU HOSPITAL

Perce DeLong—1. Operative and dry clinics.

MOUNT SINAI HOSPITAL
AARON BARLOW—4. Operations.

PENNSYLVANIA HOSPITAL
A. G. FEWELL—2. Fundus clinic.

PRESBYTERIAN HOSPITAL
H. M. LANGDON—2:30. Operative and dry clinics.

PROTESTANT EPISCOPAL HOSPITAL
ANDREW KNOX—2. Operative and dry clinics.

ST. CHRISTOPHER'S HOSPITAL
J. B. FELDMAN—2. Squint clinic.

TEMPLE UNIVERSITY HOSPITAL
WALTER I. LILLIE and staff—1. Operative and dry clinics.

WILLS HOSPITAL
J. M. GRISCOM, F. C. PARKER, and T. A. O'BRIEN—2. Operative and dry clinics.

Tuesday

CHESTNUT HILL HOSPITAL
GEORGE E. BERNER—2. Operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
WILLIAM T. SHOEMAKER—2. Operative and dry clinics.

HOSPITAL FOR DISEASES OF STOMACH
GEORGE H. DENNEY—1. Cataract cases.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
F. H. ADLER—10. Dark adaptation.
F. H. ADLER—2. Operative and dry clinics.

JEFFERSON HOSPITAL
C. E. G. SHANNON—2. Operative and dry clinics.

PHILADELPHIA GENERAL HOSPITAL
C. R. MULLEN—3. Operative and dry clinics.

PROTESTANT EPISCOPAL HOSPITAL
N. M. BRINKERHOFF—2. Operative and dry clinics.

ST. CHRISTOPHER'S HOSPITAL
J. B. FELDMAN—2. Squint clinic.

ST. JOSEPH'S HOSPITAL
THOMAS A. O'BRIEN—2. Operative and dry clinics.

ST. LUKE'S AND CHILDREN'S HOSPITAL
F. C. PETERS, S. H. BROWN, and staff—9. Operations.

ST. MARY'S HOSPITAL
F. A. MURPHY—1. Operative and dry clinics.

TEMPLE UNIVERSITY HOSPITAL
WALTER I. LILLIE and staff—1. Operative and dry clinics.

WILLS HOSPITAL
LOUIS LEHRFELD, W. S. REESE, and C. R. MULLEN—2. Operative and dry clinics.

Wednesday

BRYN MAWR HOSPITAL
T. DELORME FORDYCE—2. Operative and dry clinics.

GERMANTOWN HOSPITAL
CARL WILLIAMS and ALBERT SAUTTER—10. Operations.

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
L. C. PETER and staff—2. Operations.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
F. H. ADLER—2. Operative and dry clinics.

JEFFERSON HOSPITAL
C. E. G. SHANNON—2. Operative and dry clinics.

LANKENAU HOSPITAL
PERCE DELONG and WILLIAM CREIGHTON—1. Operative and dry clinics.

PROTESTANT EPISCOPAL HOSPITAL
ANDREW KNOX—2. Operative and dry clinics.

PRESBYTERIAN HOSPITAL
H. M. LANGDON—2:30. Operative and dry clinics.

ST. CHRISTOPHER'S HOSPITAL
J. B. FELDMAN—3. Operations.

ST. LUKE'S AND CHILDREN'S HOSPITAL
F. C. PETERS, S. H. BROWN, and staff—9. Operations.

WILLS HOSPITAL
J. M. GRISCOM, F. C. PARKER, and T. A. O'BRIEN—2. Operative and dry clinics.

Thursday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
WILLIAM T. SHOEMAKER—2. Operative and dry clinics.
EDMUND B. SPAETH—2. Plastic surgery of eye.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
EDMUND B. SPAETH—10. Dry clinic.
F. H. ADLER—2. Operative and dry clinics.

JEFFERSON HOSPITAL
C. E. G. SHANNON—2. Operative and dry clinics.

MOUNT SINAI HOSPITAL
AARON BARLOW—4. Operations.

PHILADELPHIA GENERAL HOSPITAL
C. R. MULLEN—3. Operative and dry clinics.

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N. M. BRINKERHOFF—2. Operative and dry clinics.

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J. B. FELDMAN—2. Squint clinic.

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F. C. PETERS, S. H. BROWN, and staff—9. Operations.

ST. MARY'S HOSPITAL

R. T. M. DONNELLEY—10. Operations.

TEMPLE UNIVERSITY HOSPITAL

WALTER I. LILLIE and staff—1. Operative and dry clinics.

WILLS HOSPITAL

LOUIS LEHRFELD, W. S. REESE, and C. R. MULLEN—2. Operative and dry clinics.

Friday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

L. C. PETER—2. Operations.

HAHNEMANN HOSPITAL

F. C. PETERS and staff—2. Operations.

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. S. TASSMAN—10. The conduct and methods of a refraction department in a large hospital.

F. H. ADLER—2. Operative and dry clinics.

JEFFERSON HOSPITAL

C. E. G. SHANNON—2. Operative and dry clinics.

LANKENAU HOSPITAL

PERCE DELONG—1. Operative and dry clinics.

PENNSYLVANIA HOSPITAL

A. G. FEWELL—2. Fundus clinic.

PRESBYTERIAN HOSPITAL

H. M. LANGDON—2:30. Operative and dry clinics.

PROTESTANT EPISCOPAL HOSPITAL

ANDREW KNOX—2. Operative and dry clinics.

ST. CHRISTOPHER'S HOSPITAL

J. B. FELDMAN—2. Squint clinic.

ST. LUKE'S AND CHILDREN'S HOSPITAL

F. C. PETERS, S. H. BROWN, and staff—9. Operations.

TEMPLE UNIVERSITY HOSPITAL

WALTER I. LILLIE and staff—1. Operative and dry clinics.

WILLS HOSPITAL

J. M. GRISCOM, F. C. PARKER, and T. A. O'BRIEN—2. Operative and dry clinics.

WOMEN'S HOMEOPATHIC HOSPITAL

J. R. CRISWELL and C. J. V. FRIES—2. Operative and dry clinics.

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With International Abstract of Surgery

VOLUME 68 June, 1939 NUMBER 6

BUYING PROMISES

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Index to Advertising

Abbott Laboratories, *Pharmaceuticals*... 43
A. S. Aloe Co., *Filterpure Unit*..... 10
American Can Co., *Containers*..... 36
American Cystoscope Makers, *Surgical Specialties*..... 13
American Hospital Supply Corp., *Intravenous Solutions*..... 35
American Sterilizer Co., *Operating Lights*..... 11
Armour Laboratories, *Pharmaceuticals*.. 44
Austenal Laboratories, *Fracture Appliances*..... 23

Bauer & Black, *Castex Bandage*..... 25
Baxter Laboratories, *Intravenous Solutions*..... 35
Becton, Dickinson & Co., *Syringes*..... 8
Julius Berbecker & Sons, *Surgeon's Needles*..... 32
Bethlehem Laboratories, *Pharmaceuticals* 34

S. H. Camp & Co., *Surgical Supports*... 27
Wilmot Castle Co., *Operating Lights*.... 24
Chicago Post-Graduate School of Surgery, *Postgraduate Instruction*..... 30
Cook County Graduate School of Medicine, *Postgraduate Instruction*..... 28
Crane Co., *Hospital Plumbing*..... 33
Crescent Surgical Sales, *Surgeon's Blades*..... 22
Cutter Laboratories, *Intravenous Solutions*..... 31

R. B. Davis Co., *Cocomalt*..... 39
Davis & Geck, *Sutures*..... 2
J. A. Deknatel & Son, *Silk Sutures*..... 26

E. Fougera & Co., *Pharmaceuticals*..... 40

General Electric X-Ray Corp., *X-Ray Therapy Equipment*..... 19
Gruss Surgical Mfg. Co., *Suture Needles*..... 28
Gudebrod Bros. Silk Co., *Silk Sutures*... 20

Hanovia Chemical & Mfg. Co., *Ultraviolet Sun Lamps*..... 18
Fred Haslam & Co., *Instruments*..... 20
Hoffman-LaRoche, Inc., *Pharmaceuticals*.....4th Cover
Hygeia Nursing Bottle Co., *Nursing Bottle and Nipple*..... 34

Johnson & Johnson, *Sutures*..... 15

Kny-Scheerer Corp., *Instruments*..2nd Cover

Lewis Manufacturing Co., *Castex Bandage and Sutures*.....25 and 29

J. B. Lippincott Co., *Medical Books*..... 9

Massillon Rubber Co., *Rubber Gloves*... 14
Medical Protective Co., *Professional Protection*..... 32
V. Mueller & Co., *Instruments*..... 16

New York Medical Exchange, *Professional Placement*..... 28
New York Polyclinic Medical School and Hospital, *Postgraduate Instruction*.... 28

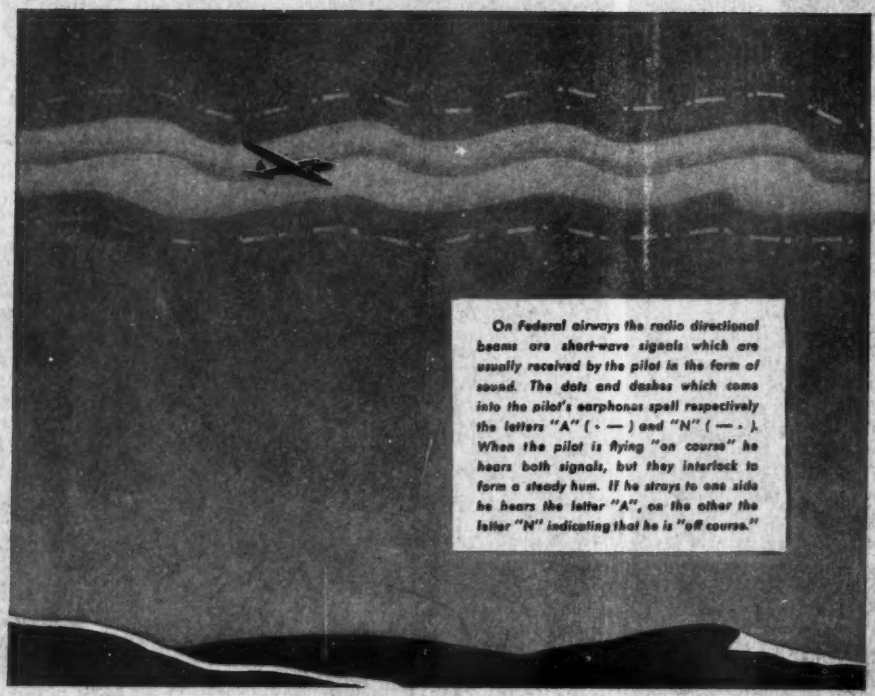
Parker, White & Heyl, Inc., *Formaldehyde Germicide and Sterilizers* 12
Patterson Screen Co., *X-Ray Screens*... 21
Petrolagar Laboratories, *Petrolagar*..... 38
George P. Pilling & Son Co., *Instruments*..... 18
Prometheus Electric Corp., *Operating Lights*..... 22

Radium Chemical Co., Inc., *Radium*.... 30
Radium Emanation Corp., *Radium*..... 26

Scanlan-Morris Co., *Instruments*..... 4
Schering Corp., *Pharmaceuticals*..... 42
J. Sklar Manufacturing Co., *Instruments*..... 7
Spencer Corset Co., *Surgical Supports*.. 24
E. R. Squibb & Sons, *Ether*..... 17
Sterilometer Laboratories, *Sterilization Control*..... 34
Sterisol Ampoule Corp., *Sterisol Ampoules*..... 32

Tower Company, *Splints*..... 22

Wallace & Tiernan Products, *Pharmaceuticals*..... 37
Westinghouse X-Ray Co., *Operating Lights*..... 6
Wilson Rubber Co., *Rubber Gloves*..... 26
Wilmot Castle Co., *Operating Lights*.... 24
Winthrop Chemical Co., *Pharmaceuticals* 41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